



A 62-year-old woman comes to the emergency department due to acute eye pain. She has a history of seasonal allergies and developed itchy, watery, red eyes after working outdoors in her garden. The patient used over-the-counter eye drops to treat her allergy symptoms, and several hours later, she began experiencing severe right eye pain and headache. On examination, the right eye appears red with a hazy cornea and dilated pupil that responds poorly to light. Palpation of the globes reveals notable firmness on the right compared to the left. Visual acuity in the affected eye is severely diminished. Tonometry reveals elevated intraocular pressure. Which of the following medications was most likely used by this patient?

- ☐ A. Alpha-adrenergic agonist
- ☐ B. Beta blocker
- ☐ C. Mast cell stabilizer
- ☐ D. Nonsteroidal anti-inflammatory drug
- ☐ E. Prostaglandin analogue

Submit



A 62-year-old woman comes to the emergency department due to acute eye pain. She has a history of seasonal allergies and developed itchy, watery, red eyes after working outdoors in her garden. The patient used over-the-counter eye drops to treat her allergy symptoms, and several hours later, she began experiencing severe right eye pain and headache. On examination, the right eye appears red with a hazy cornea and dilated pupil that responds poorly to light. Palpation of the globes reveals notable firmness on the right compared to the left. Visual acuity in the affected eye is severely diminished. Tonometry reveals elevated intraocular pressure. Which of the following medications was most likely used by this patient?



A. Alpha-adrenergic agonist (70%)



B. Beta blocker (8%)



C. Mast cell stabilizer (5%)



D. Nonsteroidal anti-inflammatory drug (6%)



E. Prostaglandin analogue (9%)





Item 1 of 27

Question Id: 13554



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



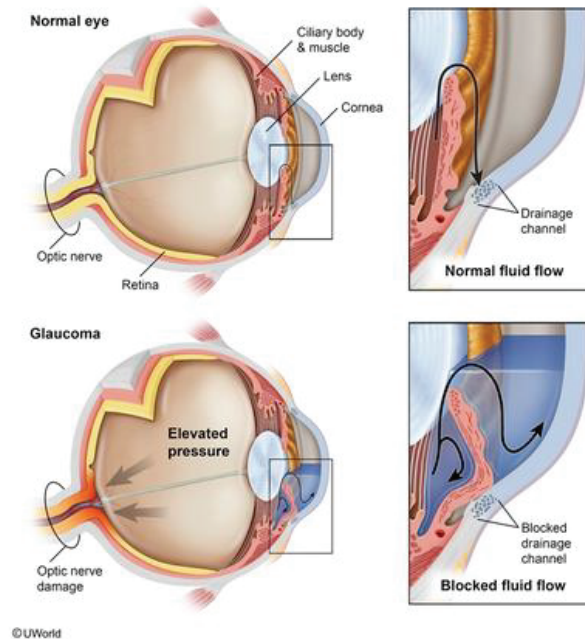
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Exhibit Display

Angle-closure glaucoma



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Block Time Remaining: 00:01:17

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This patient is presenting with **angle-closure glaucoma** (ACG) that was precipitated by use of over-the-counter eye drops. ACG typically occurs in patients with a predisposing narrow chamber angle and develops when the normal drainage pathway of aqueous humor becomes blocked.

Aqueous humor is produced by the ciliary body and flows from the posterior chamber of the eye through the pupil into the anterior chamber and out of the eye via the trabecular network. In susceptible individuals, dilation of the pupil causes the iris to press against the anterior surface of the lens. This limits flow of aqueous humor through the pupil, causing the iris to bulge forward. The corresponding reduction (closing) of the iridocorneal angle blocks drainage of aqueous humor through the trabecular meshwork.

Acute ACG may be precipitated by topical and systemic medications that cause **pupillary dilation**, such as **alpha-adrenergic agonists** (eg, naphazoline) and drugs with strong **anticholinergic** effects (eg, tricyclic antidepressants, antihistamines). Acute blockage results in a rapid rise in intraocular pressure that typically causes **severe eye pain**, **conjunctival injection**, and **corneal edema** (haziness). If not corrected, the elevated pressure can damage the optic nerve and cause permanent vision impairment.

(Choice B) Topical beta blockers (eg, timolol) are used to treat open-angle glaucoma. They work by both reducing the production of aqueous humor and increasing its outflow from the trabecular network.





elevated pressure can damage the optic nerve and cause permanent vision impairment.

(Choice B) Topical beta blockers (eg, timolol) are used to treat open-angle glaucoma. They work by both reducing the production of aqueous humor and increasing its outflow from the trabecular network.

(Choices C and D) Topical mast cell stabilizers (eg, cromolyn, nedocromil) and nonsteroidal anti-inflammatory drugs (eg, ketorolac) are used in the treatment of allergic conjunctivitis, but they are not associated with ACG.

(Choice E) Prostaglandin analogues such as latanoprost increase aqueous outflow from the trabecular network and are used in the treatment of open-angle glaucoma.

Educational objective:

Acute angle-closure glaucoma occurs when the space between the cornea and iris is narrowed, limiting the flow of aqueous humor out of the anterior chamber and raising pressure in the eye. Medications that cause pupillary dilation (eg, alpha-adrenergic agonists, anticholinergics) can trigger acute angle-closure glaucoma.

References

- [The pathophysiology and treatment of glaucoma: a review.](#)





A 65-year-old male complains of bilateral visual difficulty that has progressed over the last year.

Funduscopy reveals small yellow retinal lesions clustered in the macula. Which of the following would you expect most on visual field examination?

- ☐ A. Homonymous hemianopsia
- ☐ B. Binasal hemianopsia
- ☐ C. Bitemporal hemianopsia
- ☐ D. Arcuate scotomas
- ☐ E. Central scotomas

Submit





A 65-year-old male complains of bilateral visual difficulty that has progressed over the last year.

Funduscopy reveals small yellow retinal lesions clustered in the macula. Which of the following would you expect most on visual field examination?

- ☐ A. Homonymous hemianopsia (2%)
- ☐ B. Binasal hemianopsia (1%)
- ☐ C. Bitemporal hemianopsia (5%)
- ☐ D. Arcuate scotomas (7%)
- ☒ E. Central scotomas (81%)

Correct



81%

Answered correctly



59 secs

Time Spent



01/30/2021

Last Updated

Explanation



The macula is a yellowish spot approximately 1.5 mm in diameter located near the center of the retina. It is characterized histologically by the presence of densely packed cones, few overlying cells and no blood vessels. Each macular cone synapses to a single bipolar cell, which, in turn, synapses to a single ganglion cell. Due to this arrangement the visual acuity in the macula, and particularly the fovea, is greater than in any other area of the retina. The neural fibers that serve the macula transmit to an area of the occipital visual cortex that is separate from the area of representation of the peripheral fields (this area is also relatively large in size). Due to this peculiar cortical representation, macular sparing is common in lesions of the occipital cortex.

Macular lesions impair central vision and result in central scotomata (**Choice E**). The term **scotoma** refers to any visual defect surrounded by a relatively unimpaired field of vision. Scotomas occur due to pathologic processes that involve parts of the retina or optic nerve. Examples of such processes include demyelinating diseases such as multiple sclerosis, diabetic retinopathy and retinitis pigmentosa.

Pathologic processes that involve the entire optic nerve lead to monocular blindness.

The patient described in this clinical vignette is likely to have macular degeneration (MD). This disorder is frequently age-related, and is the most common cause of blindness in people over 50 years old in the US.



frequently age-related, and is the most common cause of blindness in people over 50 years old in the US.

Macular degeneration is characterized by progressive loss of central vision due to deposition of fatty tissue (drusen) behind the retina (dry MD) and neovascularization of the retina (wet MD).

(Choice A) Homonymous hemianopsia is a loss of vision in the same side of the visual field in both eyes.

It occurs due to transection of the contralateral optic tract, the fibers of the visual pathway linking the optic chiasm to the lateral geniculate body.

(Choice B) Binasal hemianopsia is a loss of vision in the nasal fields of both eyes. It is caused by pressure to the lateral areas of the optic chiasm. This may result from calcified carotid arteries.

(Choice C) Bitemporal hemianopsia is a loss of vision in the temporal fields of both eyes. It is caused by compression of the medial part of the optic chiasm, where the nasal fibers decussate, most commonly by a pituitary adenoma.

(Choice D) Arcuate scotomas occur due to damage to a particular region of the optic nerve head. The resulting visual field defect follows the arcuate shape of the nerve fiber pattern.

Educational Objective:

A scotoma is a visual field defect that occurs due to a pathologic process that involves parts of the retina or the optic nerve resulting in a discrete area of altered vision surrounded by zones of normal vision. Lesions



chiasm to the lateral geniculate body.

(Choice B) Binasal hemianopsia is a loss of vision in the nasal fields of both eyes. It is caused by pressure to the lateral areas of the optic chiasm. This may result from calcified carotid arteries.

(Choice C) Bitemporal hemianopsia is a loss of vision in the temporal fields of both eyes. It is caused by compression of the medial part of the optic chiasm, where the nasal fibers decussate, most commonly by a pituitary adenoma.

(Choice D) Arcuate scotomas occur due to damage to a particular region of the optic nerve head. The resulting visual field defect follows the arcuate shape of the nerve fiber pattern.

Educational Objective:

A scotoma is a visual field defect that occurs due to a pathologic process that involves parts of the retina or the optic nerve resulting in a discrete area of altered vision surrounded by zones of normal vision. Lesions of the macula cause central scotomas.

Pathophysiology

Ophthalmology

Macular degeneration

Subject

System

Topic

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A 14-year-old boy is brought to the clinic by his mother due to changes in vision. For the last few weeks, the patient has been squinting when trying to read the interactive whiteboard in class and has had to sit closer to the front of the room. He has also developed headaches. The patient has no chronic medical conditions and takes no medications. Temperature is 37.2 C (99 F), blood pressure is 116/76 mm Hg, and pulse is 70/min. Examination of the eyes shows equal and reactive pupils. Extraocular muscles are intact, and visual field testing reveals no defects. Visual acuity shows 20/70 in both eyes. His ability to read close text is normal. Which of the following is the most likely cause of this patient's symptoms?

- ☐ A. Chronically increased intraocular pressure
- ☐ B. Disturbance in development of the visual cortex
- ☐ C. Increased anterior-posterior diameter of the eyes
- ☐ D. Loss of accommodating power of the lens
- ☐ E. Refracted image focused posterior to the retina

Submit



A 14-year-old boy is brought to the clinic by his mother due to changes in vision. For the last few weeks, the patient has been squinting when trying to read the interactive whiteboard in class and has had to sit closer to the front of the room. He has also developed headaches. The patient has no chronic medical conditions and takes no medications. Temperature is 37.2 C (99 F), blood pressure is 116/76 mm Hg, and pulse is 70/min. Examination of the eyes shows equal and reactive pupils. Extraocular muscles are intact, and visual field testing reveals no defects. Visual acuity shows 20/70 in both eyes. His ability to read close text is normal. Which of the following is the most likely cause of this patient's symptoms?

- ☐ A. Chronically increased intraocular pressure (2%)
- ☐ B. Disturbance in development of the visual cortex (0%)
- ☒ C. Increased anterior-posterior diameter of the eyes (54%)
- ☐ D. Loss of accommodating power of the lens (7%)
- ☐ E. Refracted image focused posterior to the retina (35%)

Incorrect

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Feedback



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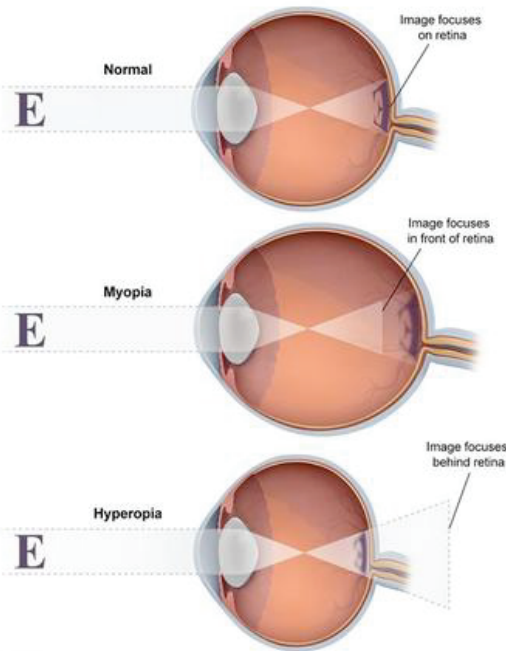


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Refractive errors



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This patient with decreased visual acuity and an otherwise normal ophthalmic examination likely has simple **myopia (nearsightedness)**, a **refractive error** caused by an **increased anterior-posterior diameter** of the eye. The risk is greatest for those with a positive family history or those of East Asian descent.

During the adolescent growth spurt, the axial length of the globe also grows rapidly, making the incidence of new-onset myopia highest in this age group. As the anterior-posterior diameter increases, the focal point of a **refracted image lies anterior to the retina**. For images to be seen clearly, they must be projected directly onto the retina; therefore, the image displacement in myopia causes **blurred vision** of **long-distance** objects and decreased visual acuity on examination. **Vision** of **nearby** objects is unaffected and appears **clear** in myopic patients. The remainder of the examination, including extraocular movements, peripheral field testing, and funduscopy examination, is normal.

Management is with prescription glasses with a diverging (concave) lens, which refocuses the refracted image onto the retina. The degree of myopia usually stabilizes by early adulthood.

(Choice A) **Glaucoma**, most commonly due to chronically elevated intraocular pressure, is characterized by optic neuropathy, as evidenced by optic cupping seen on funduscopy examination. Visual acuity may be affected but is a late manifestation after progressive loss of peripheral vision, which is normal in this patient

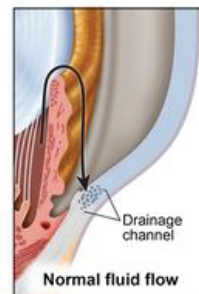
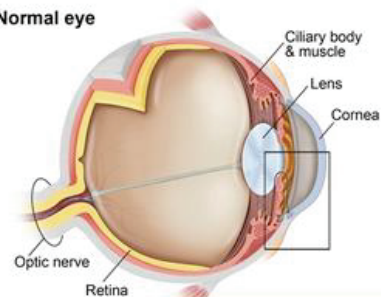




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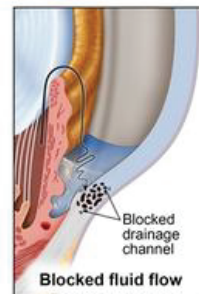
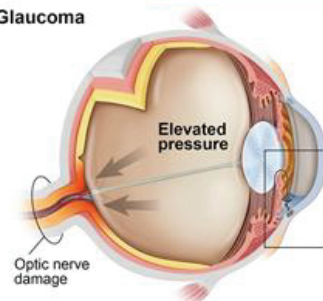
Glaucoma pathophysiology

Normal eye



Normal fluid flow

Glaucoma



Blocked fluid flow

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patient.

(Choice B) Untreated **strabismus** (misalignment of the eyes) in early childhood can cause unilateral visual cortex suppression to avoid diplopia and eventually lead to amblyopia (decreased visual acuity). This patient's recent symptom onset and normal extraocular movements make this diagnosis unlikely.

(Choice D) **Presbyopia** is a nonrefractive error that increases with age due to the loss of accommodating power of the lens from decreased elasticity. Blurry vision of nearby objects typically develops in patients age >40.

(Choice E) **Hyperopia** (farsightedness) is a refractive error characterized by a reduced anterior-posterior diameter of the eye, causing the focal point of the refracted image to be positioned posterior to the retina. In contrast to myopia, hyperopia causes blurred vision of nearby objects and is corrected by a converging (convex) lens.

Educational objective:

Myopia (nearsightedness) is a refractive error in which the focal point of an image falls anterior to the retina due to an increased anterior-posterior diameter of the eyes. Patients have difficulty seeing objects at a distance and have normal near vision.

References





Item 3 of 27

Question Id: 18896



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



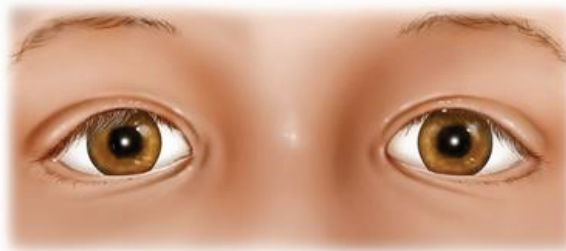
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Strabismus



Normal eyes



Esotropia (strabismus)

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References

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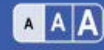
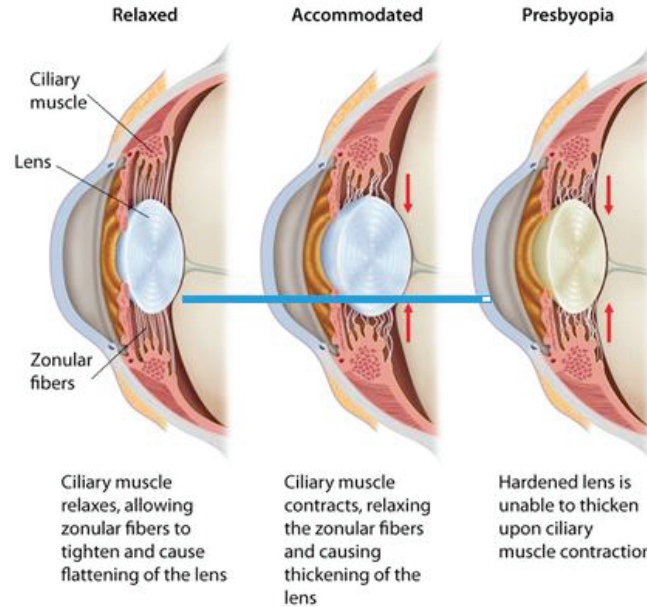


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Ocular accommodation and presbyopia



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References

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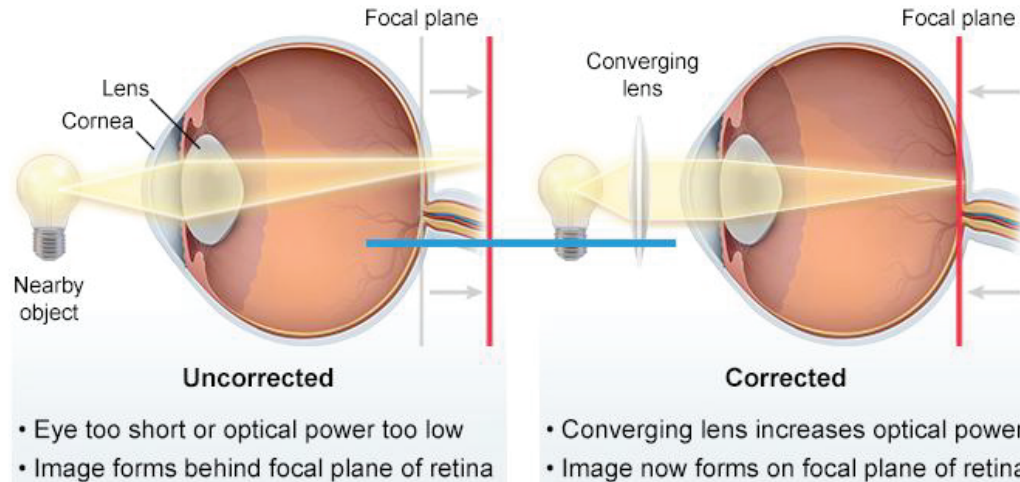


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Hyperopia (farsightedness)



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New



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References

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A 22-year-old woman comes to the office for a routine prenatal visit. She is 16 weeks pregnant with her first child. Two months ago, she had a mononucleosis-like illness with fever, myalgia, and fatigue, and she was diagnosed with cytomegalovirus infection. The patient recovered with symptomatic treatment and is currently asymptomatic. Her other medical problems include episodic migraine headaches and benign choroidal nevus. She takes prenatal vitamins and does not use tobacco, alcohol, or illicit drugs. The patient has a family history of hypertension and glaucoma. Physical examination findings and prenatal ultrasound are unremarkable. This patient's unborn infant is at greatest risk for which of the following eye conditions?

- ☐ A. Chorioretinitis
- ☐ B. Choroidal nevus
- ☐ C. Congenital cataract
- ☐ D. Glaucoma
- ☐ E. Inclusion conjunctivitis
- ☐ F. Retinitis pigmentosa





first child. Two months ago, she had a mononucleosis-like illness with fever, myalgia, and fatigue, and she was diagnosed with cytomegalovirus infection. The patient recovered with symptomatic treatment and is currently asymptomatic. Her other medical problems include episodic migraine headaches and benign choroidal nevus. She takes prenatal vitamins and does not use tobacco, alcohol, or illicit drugs. The patient has a family history of hypertension and glaucoma. Physical examination findings and prenatal ultrasound are unremarkable. This patient's unborn infant is at greatest risk for which of the following eye conditions?

- ☐ A. Chorioretinitis
- ☐ B. Choroidal nevus
- ☐ C. Congenital cataract
- ☐ D. Glaucoma
- ☐ E. Inclusion conjunctivitis
- ☐ F. Retinitis pigmentosa
- ☐ G. Retinoblastoma



currently asymptomatic. Her other medical problems include episodic migraine headaches and benign choroidal nevus. She takes prenatal vitamins and does not use tobacco, alcohol, or illicit drugs. The patient has a family history of hypertension and glaucoma. Physical examination findings and prenatal ultrasound are unremarkable. This patient's unborn infant is at greatest risk for which of the following eye conditions?

- ☒ A. Chorioretinitis (60%)
- ☐ B. Choroidal nevus (2%)
- ☐ C. Congenital cataract (18%)
- ☐ D. Glaucoma (3%)
- ☐ E. Inclusion conjunctivitis (8%)
- ☐ F. Retinitis pigmentosa (5%)
- ☐ G. Retinoblastoma (1%)

Correct

60%

01 min, 09 secs

01/14/2021



Up to 5% of women develop a **primary cytomegalovirus (CMV) infection** (typically a mononucleosis-like illness with fever and mild hepatitis) during pregnancy. Vertical transmission to the fetus occurs in approximately one-third of cases, with the highest risk of transmission occurring in the first trimester. **CMV-related complications** observed in infants exposed to the virus **in utero** include **chorioretinitis** (most common eye-related problem), sensorineural deafness, seizures, jaundice, hepatomegaly, splenomegaly, and microcephaly.

(Choice B) Choroidal nevus (eye freckle) is a nonhereditary, usually benign pigmented area underneath the retina and is not associated with in-utero CMV infection.

(Choice C) Congenital cataract can be seen with in-utero rubella infection.

(Choice D) Glaucoma can be present at birth and may be primary or secondary (eg, tumor). However, it is not a known complication of CMV infection.

(Choice E) Inclusion conjunctivitis is seen with *Chlamydia trachomatis* infection of the newborn.

(Choice F) Retinitis pigmentosa is an inherited degenerative eye disease that leads to severe vision impairment and is not a complication of in-utero CMV infection.

(Choice G) Retinoblastoma is the most common malignant eye cancer in children and is caused by a





(Choice D) Glaucoma can be present at birth and may be primary or secondary (eg, tumor). However, it is not a known complication of CMV infection.

(Choice E) Inclusion conjunctivitis is seen with *Chlamydia trachomatis* infection of the newborn.

(Choice F) Retinitis pigmentosa is an inherited degenerative eye disease that leads to severe vision impairment and is not a complication of in-utero CMV infection.

(Choice G) Retinoblastoma is the most common malignant eye cancer in children and is caused by a chromosomal mutation that is hereditary or sporadic. CMV infection in utero is not associated with causing retinoblastoma.

Educational objective:

The most common eye-related complication of congenital cytomegalovirus infection is chorioretinitis.

References

- [Ocular abnormalities in congenital cytomegalovirus infection.](#)

Microbiology

Ophthalmology

Cytomegalovirus

Subject

System

Topic





A 17-year-old boy is brought to the clinic due to poor vision at night. The patient developed mild difficulty seeing at night about 4 months ago, and it has slowly worsened. Visual field examination shows visual loss in the midperiphery. External eye examination reveals normal tear formation. Fundusoscopic examination shows bilateral optic disc pallor, attenuation of retinal vessels, and areas of dark discoloration in the retina. Which of the following is the most likely mechanism of this patient's visual impairment?

- ☐ A. Biallelic inactivation of *RB1* gene
- ☐ B. Genetic progressive retinal dystrophy
- ☐ C. Increased intracranial pressure
- ☐ D. Poor aqueous outflow due to narrow angle
- ☐ E. Retinal artery occlusion

Submit



A 17-year-old boy is brought to the clinic due to **poor vision at night**. The patient developed mild difficulty seeing at night about 4 months ago, and it has slowly worsened. Visual field examination shows visual loss in the **midperiphery**. External eye examination reveals normal tear formation. Fundusoscopic examination shows **bilateral optic disc pallor**, **attenuation** of **retinal vessels**, and areas of dark discoloration in the retina. Which of the following is the most likely mechanism of this patient's visual impairment?

- ☐ A. ~~Biallelic inactivation of *RB1* gene~~ (16%)
- ✓ ☒ B. Genetic progressive retinal dystrophy (59%)
- ☐ C. ~~Increased intracranial pressure~~ (8%)
- ☐ D. ~~Poor aqueous outflow due to narrow angle~~ (4%)
- ☐ E. Retinal artery occlusion (10%)

Correct

59%
Answered correctly

01 min, 11 secs
Time Spent

11/12/2020
Last Updated



Retinitis pigmentosa

Etiology	<ul style="list-style-type: none">• Genetic dystrophy• Progressive retinal degeneration (photoreceptors, pigmented epithelium)
Clinical features	<ul style="list-style-type: none">• Loss of rods:<ul style="list-style-type: none">◦ Night blindness◦ Peripheral visual field loss• Loss of cones:<ul style="list-style-type: none">◦ Decreased central visual acuity (late finding)
Funduscopy changes	<ul style="list-style-type: none">• Retinal vessel attenuation (likely due to altered metabolic demand)• Optic disc pallor (optic nerve atrophy and gliosis)• Pigment accumulation (characteristic bone-spicule pattern around vessels)

This patient has poor night vision, visual field loss, and funduscopy changes (eg, pigment accumulation, optic disc pallor, retinal vessel attenuation) consistent with **retinitis pigmentosa**, a genetic disease





This patient has poor night vision, visual field loss, and fundusoscopic changes (eg, pigment accumulation, optic disc pallor, retinal vessel attenuation) consistent with **retinitis pigmentosa**, a genetic disease characterized by **progressive dystrophy** of the retinal pigmented epithelium and **photoreceptors** (eg, rods, cones).

Rods, which are highly metabolically active and most prevalent in the periphery, are affected first, leading to the initial manifestations of **progressive night blindness** and **loss of peripheral vision**. Early fundusoscopic changes include **retinal vessel attenuation** (ie, narrow vessels likely due to alterations in retinal metabolic demand) and a waxy, pale optic disc (due to optic nerve atrophy and gliosis).

In advanced disease, loss of cones (most prevalent in the central retina) causes decreased central visual acuity. Degeneration of retinal pigmented epithelial cells releases **pigment**, which **deposits** in a characteristic **bone-spicule pattern** over the course of the disease.

(Choice A) Retinoblastoma, which is caused by inactivation of both alleles of the *RB1* gene (ie, **2-hit hypothesis**), typically presents in the first 3 years of life with leukocoria (ie, **white pupillary reflex**), strabismus, and a creamy-white mass on fundusoscopic examination.

(Choice C) Increased intracranial pressure can be associated with transient visual obscuration and





Item 5 of 27

Question Id: 19126



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



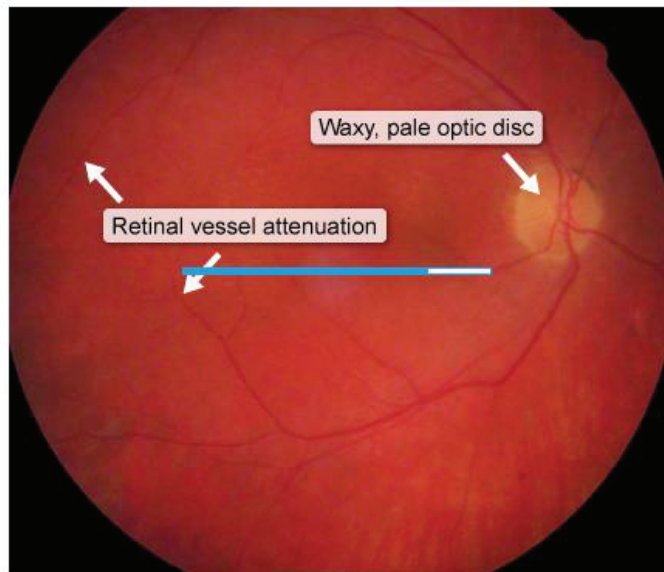
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Retinitis pigmentosa



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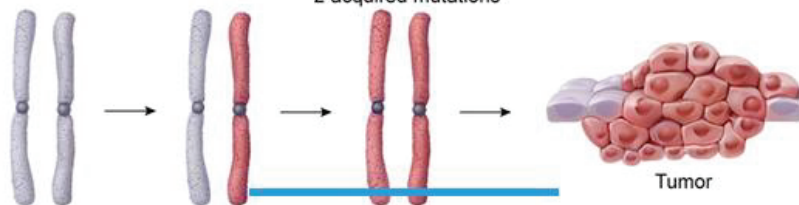


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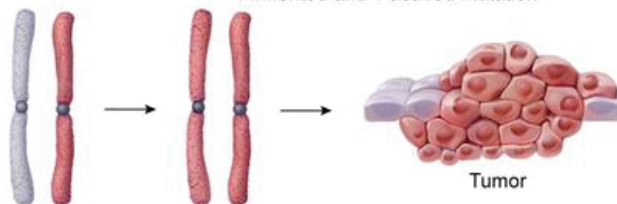
Knudson's 2-hit hypothesis

Both copies of the gene must be knocked out to promote malignancy.

Sporadic cancer:
2 acquired mutations



Hereditary cancer:
1 inherited and 1 acquired mutation



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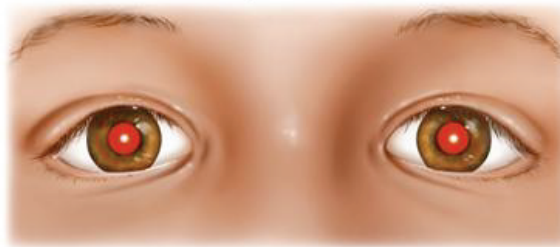
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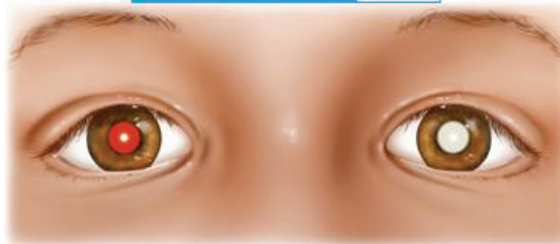
Exhibit Display

Normal eyes & white reflex



Normal eyes

Red reflexes & corneal light reflexes are equal.



Absent reflex

White reflex on abnormal eye can result from opacities of the lens (eg, cataract) or tumor (eg, retinoblastoma).

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strabismus, and a creamy-white mass on fundusoscopic examination.

(Choice C) Increased intracranial pressure can be associated with transient visual obscuration and decreased visual acuity. However, other symptoms (eg, headache, vomiting) are also typically present and **papilledema** with blurred optic disc margins would be seen on funduscopy.

(Choice D) **Angle-closure glaucoma** occurs due to narrowing of the angle between the iris and the cornea, which blocks aqueous outflow. Patients typically have acute eye pain and vision loss with conjunctival erythema, cornea edema, and a mid-dilated, poorly reactive pupil. Optic nerve atrophy secondary to chronically increased intraocular pressure results in **optic nerve cupping** on funduscopy.

(Choice E) Central retinal artery occlusion typically presents with unilateral painless acute vision loss in patients age >40 with thromboembolic risk factors (eg, hypertension). **Retinal whitening** and a cherry-red macula are the characteristic fundusoscopic changes.

Educational objective:

Retinitis pigmentosa is a genetic condition resulting in progressive dystrophy of retinal pigmented epithelium and photoreceptors. Patients typically present with progressive night blindness and loss of peripheral vision due to early loss of rods, which are highly metabolically active. Fundusoscopic examination may show dark pigments deposited in a bone-spicule pattern in addition to retinal vessel attenuation and



Item 5 of 27

Question Id: 19126



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color

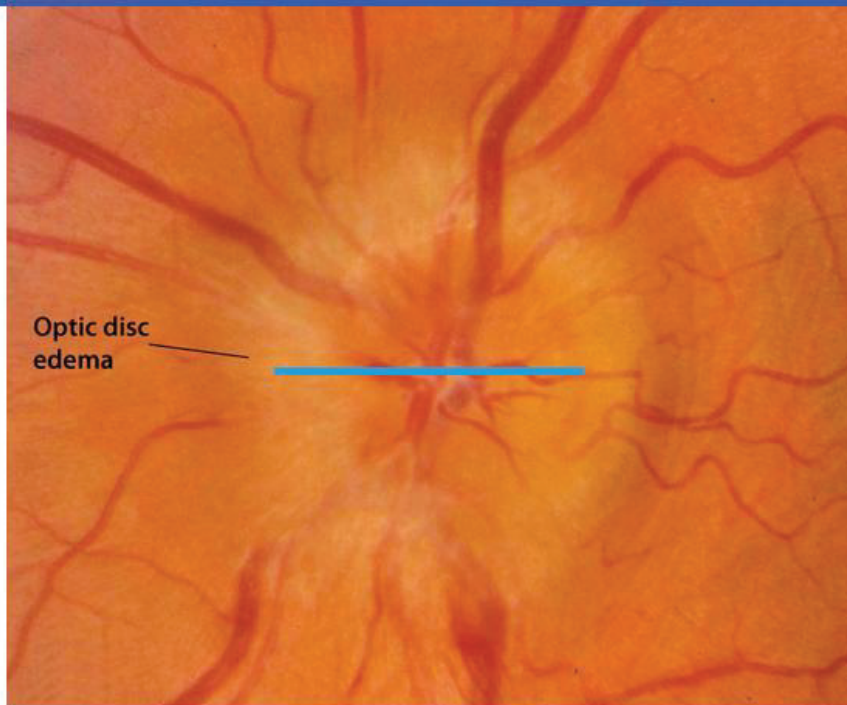


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Feedback



Suspend

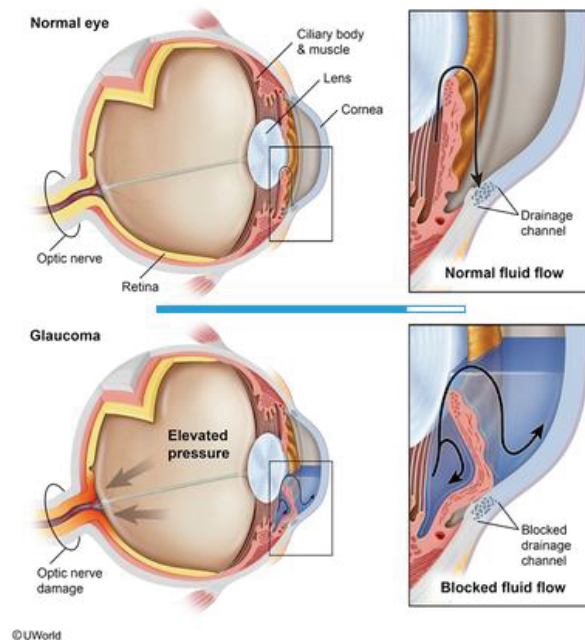


End Block



Exhibit Display

Angle-closure glaucoma



Zoom In



Zoom Out



Reset



New | Existing



My Notebook

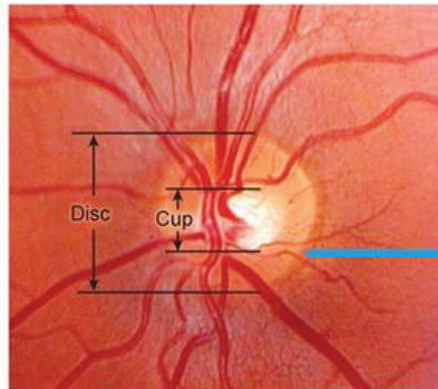




Exhibit Display

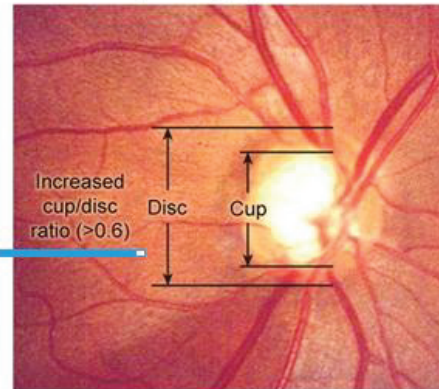
Optic disc in glaucoma

Normal



- Cup/disc ratio < 0.5
- Clear disc rim

Open-angle glaucoma



- Enlarged cup with cup/disc ratio > 0.6
- Increase in cup size over time
- Thinning of disc rim
- Pale disc (optic nerve atrophy)

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Zoom In



Zoom Out



Reset



New



Existing



My Notebook





Item 5 of 27

Question Id: 19126



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



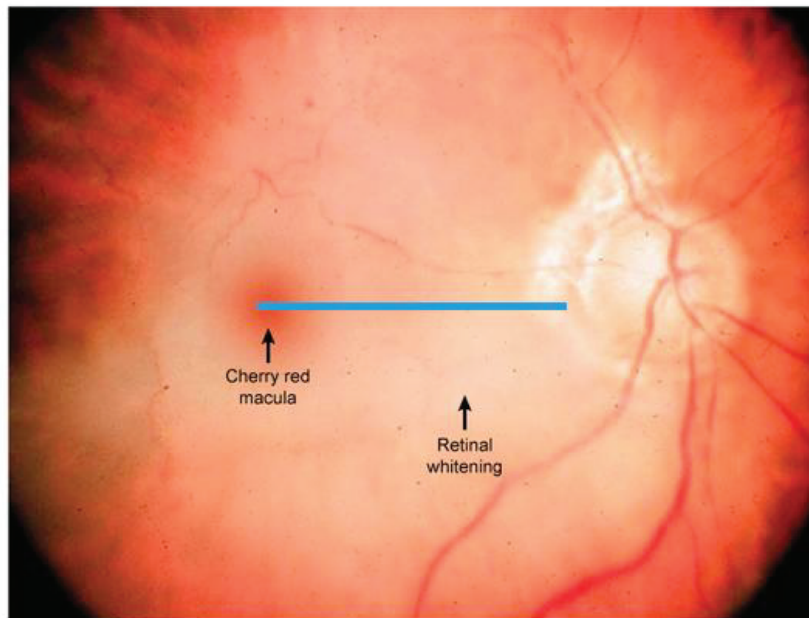
Text Zoom



Settings

Exhibit Display

Central retinal artery occlusion



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Zoom In



Zoom Out



Reset



New



Existing



My Notebook

Block Time Remaining: 00:05:54

TUTOR

<https://t.me/USMLEWorldStep1>



1



Feedback



Suspend



End Block

decreased visual acuity. However, other symptoms (eg, headache, vomiting) are also typically present and **papilledema** with blurred optic disc margins would be seen on funduscopy.

(Choice D) **Angle-closure glaucoma** occurs due to narrowing of the angle between the iris and the cornea, which blocks aqueous outflow. Patients typically have acute eye pain and vision loss with conjunctival erythema, cornea edema, and a mid-dilated, poorly reactive pupil. Optic nerve atrophy secondary to chronically increased intraocular pressure results in **optic nerve cupping** on funduscopy.

(Choice E) Central retinal artery occlusion typically presents with unilateral painless acute vision loss in patients age >40 with thromboembolic risk factors (eg, hypertension). **Retinal whitening** and a cherry-red macula are the characteristic fundusoscopic changes.

Educational objective:

Retinitis pigmentosa is a genetic condition resulting in progressive dystrophy of retinal pigmented epithelium and photoreceptors. Patients typically present with progressive night blindness and loss of peripheral vision due to early loss of rods, which are highly metabolically active. Funduscopy examination may show dark pigments deposited in a bone-spicule pattern in addition to retinal vessel attenuation and optic disc pallor.

References



A 68-year-old woman comes to the emergency department due to sudden-onset double vision that started immediately after she woke up. The patient notices that her vision worsens when looking to the right. She has no headache, weakness, or numbness. The patient has a prolonged history of hypertension, hyperlipidemia, and type 2 diabetes mellitus. Blood pressure is 160/90 mm Hg and pulse is 86/min and regular. Neurologic examination, including visual acuity, is normal with the exception of the ocular findings shown in the image below.



Rightward
gaze



Neutral





Item 6 of 27

Question Id: 12083



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



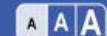
Notes



Calculator



Reverse Color

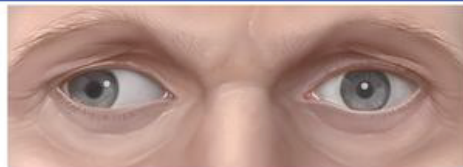


Text Zoom



Settings

Exhibit Display



Rightward gaze



Neutral



Leftward gaze



Convergence

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Zoom In



Zoom Out



Reset



New



Existing



My Notebook

Block Time Remaining: 00:05:59

TUTOR

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Feedback



Suspend



End Block

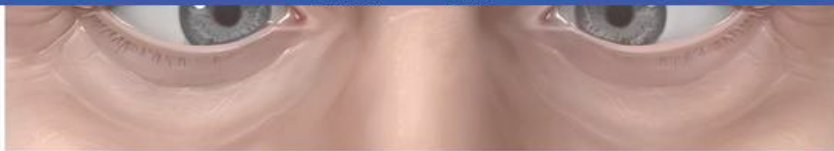


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A lesion involving which of the following structures is most likely causing the observed ocular findings in this patient?

- ☐ A. Abducens nerve
- ☐ B. Lateral geniculate nucleus
- ☐ C. Medial longitudinal fasciculus
- ☐ D. Occipital lobe
- ☐ E. Oculomotor nerve
- ☐ F. Superior colliculus

Submit



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A lesion involving which of the following structures is most likely causing the observed ocular findings in this patient?

- ☐ A. Abducens nerve (10%)
- ☐ B. Lateral geniculate nucleus (5%)
- ☒ C. Medial longitudinal fasciculus (67%)
- ☐ D. Occipital lobe (0%)
- ☐ E. Oculomotor nerve (14%)
- ☐ F. Superior colliculus (1%)

Correct

67%

44 secs

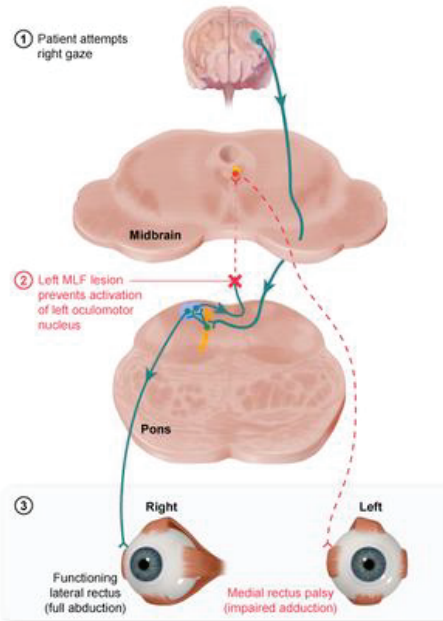
01/03/2021





Exhibit Display

Gaze palsy with left internuclear ophthalmoplegia



MLF = medial longitudinal fasciculus.
OUWorld



Zoom In



Zoom Out



Reset



New | Existing



My Notebook





This patient has **internuclear ophthalmoplegia**, a disorder of impaired horizontal gaze caused by damage to the **medial longitudinal fasciculus (MLF)**. The frontal eye field initiates horizontal gaze through the contralateral abducens (CN VI) nucleus, which communicates with the ipsilateral oculomotor (CN III) nucleus by way of the MLF. This allows for simultaneous activation of the lateral rectus muscle in the contralateral eye (abduction) and the medial rectus muscle in the ipsilateral eye (adduction), resulting in **coordinated conjugate horizontal gaze**.

Unilateral MLF lesions typically occur in older patients with lacunar strokes in the dorsal pons or midbrain (pontine artery distribution) and result in **impaired adduction** of the **ipsilateral eye** during horizontal gaze, causing **diplopia**. Abduction in the contralateral eye is preserved (but often with gaze-evoked nystagmus). The pathways for **convergence** and the pupillary light reflex bypass the MLF lesion, so these reflexes are generally **preserved**.

(Choice A) The abducens nerves innervate the lateral rectus muscles, which abduct the eyes. A lesion involving an abducens nerve would result in impaired abduction of the ipsilateral eye due to **lateral rectus muscle palsy**.

(Choice B) The lateral geniculate nucleus is located in the thalamus and relays visual information to the ipsilateral primary visual cortex. Damage to this structure would result in a contralateral homonymous





Item 6 of 27

Question Id: 12083



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color

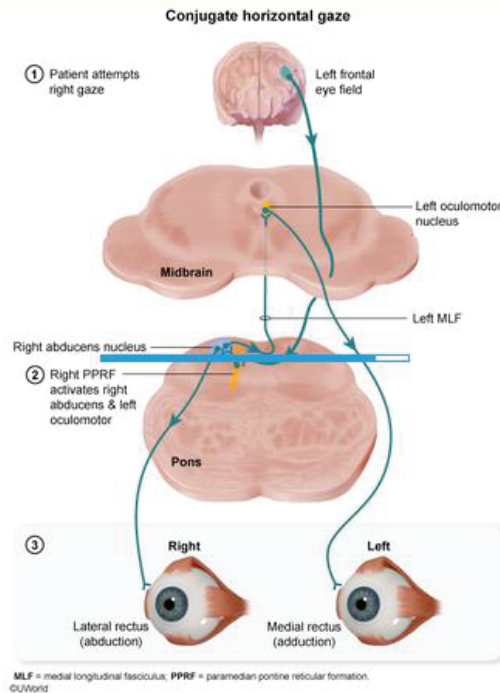


Text Zoom



Settings

Exhibit Display



Zoom In



Zoom Out



Reset



New



Existing



My Notebook

Block Time Remaining: 00:06:38

TUTOR

<https://t.me/USMLEWorldStep1>

Feedback



Suspend



End Block



Item 6 of 27

Question Id: 12083



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



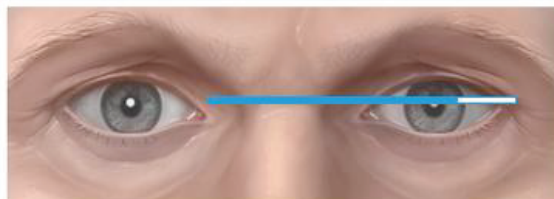
Settings

Exhibit Display

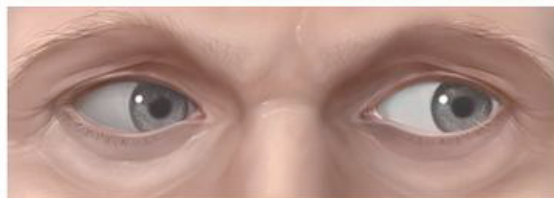
Right abducens nerve palsy



Rightward gaze



Neutral



Leftward gaze

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Zoom In



Zoom Out



Reset



New



Existing



My Notebook

Block Time Remaining: 00:06:38

TUTOR

<https://t.me/USMLEWorldStep1>



0



Feedback



Suspend



End Block

muscle palsy.

(Choice B) The lateral geniculate nucleus is located in the thalamus and relays visual information to the ipsilateral primary visual cortex. Damage to this structure would result in a contralateral homonymous hemianopia.

(Choice D) Unilateral infarction of the primary visual cortex in the occipital lobe (eg, posterior cerebral artery occlusion) typically results in contralateral homonymous hemianopia with macular sparing as the macula receives collateral circulation from the middle cerebral artery.

(Choice E) Oculomotor nerve palsy (eg, ipsilateral mydriasis, ptosis, "down and out" deviation of the eye) may occur with microvascular nerve ischemia (eg, diabetes mellitus) or nerve compression (eg, posterior communicating artery aneurysm).

(Choice F) The superior colliculus controls vertical gaze. Damage to the superior colliculus in the dorsal midbrain causes Parinaud syndrome (eg, upward gaze palsy, absent pupillary light reflex, impaired convergence).

Educational objective:

Internuclear ophthalmoplegia is a disorder of impaired horizontal gaze caused by a lesion in the medial longitudinal fasciculus (MLF). The affected eye (ipsilateral to the lesion) is unable to adduct while the



(Choice D) Unilateral infarction of the primary visual cortex in the occipital lobe (eg, posterior cerebral artery occlusion) typically results in contralateral homonymous hemianopia with macular sparing as the macula receives collateral circulation from the middle cerebral artery.

(Choice E) Oculomotor nerve palsy (eg, ipsilateral mydriasis, ptosis, "down and out" deviation of the eye) may occur with microvascular nerve ischemia (eg, diabetes mellitus) or nerve compression (eg, posterior communicating artery aneurysm).

(Choice F) The superior colliculus controls vertical gaze. Damage to the superior colliculus in the dorsal midbrain causes Parinaud syndrome (eg, upward gaze palsy, absent pupillary light reflex, impaired convergence).

Educational objective:

Internuclear ophthalmoplegia is a disorder of impaired horizontal gaze caused by a lesion in the medial longitudinal fasciculus (MLF). The affected eye (ipsilateral to the lesion) is unable to adduct while the contralateral eye is able to abduct (often with associated nystagmus). Convergence and the pupillary light reflex are preserved because these pathways bypass the MLF.

References

- [Brainstem pathways for horizontal eye movement: pathologic correlation with MR imaging.](#)





A 52-year-old man comes to the office after his wife noted that his eyes appeared different. The patient reports no symptoms. Medical history is significant for hypertension and type 2 diabetes mellitus. He has smoked 1.5 packs of cigarettes daily for 25 years. Blood pressure is 140/86 mm Hg and pulse is 84/min. On physical examination, the right pupil is 3 mm and the left pupil is 5 mm. When the light in the examination room is dimmed, the anisocoria increases. Which of the following is the most likely location of the lesion?

- ☐ A. Left oculomotor nerve
- ☐ B. Left oculosympathetic pathway
- ☐ C. Left optic nerve
- ☐ D. Right oculomotor nerve
- ☐ E. Right oculosympathetic pathway
- ☐ F. Right optic nerve

Submit



A 52-year-old man comes to the office after his wife noted that his eyes appeared different. The patient reports no symptoms. Medical history is significant for hypertension and type 2 diabetes mellitus. He has smoked 1.5 packs of cigarettes daily for 25 years. Blood pressure is 140/86 mm Hg and pulse is 84/min. On physical examination, the right pupil is 3 mm and the left pupil is 5 mm. When the light in the examination room is dimmed, the anisocoria increases. Which of the following is the most likely location of the lesion?

- ☐ A. Left oculomotor nerve (18%)
- ☐ B. Left oculosympathetic pathway (14%)
- ☐ C. Left optic nerve (6%)
- ☐ D. Right oculomotor nerve (12%)
- ☒ E. Right oculosympathetic pathway (40%)
- ☐ F. Right optic nerve (7%)





Exhibit Display

Pupillary asymmetry

In room light



Sympathetic defect (right eye)

Increases in dim light



Decreases in bright light



Parasympathetic defect (left eye)

Increases in bright light



Decreases in dim light



Zoom In



Zoom Out



Reset



New



Existing



My Notebook

This patient has **anisocoria** (ie. pupillary asymmetry) which indicates a **unilateral defect** in input from





This patient has **anisocoria** (ie, pupillary asymmetry), which indicates a **unilateral defect** in input from either the ocular sympathetic (pupil dilation) or parasympathetic (pupil constriction) pathway. In response to **dim light**, input from the **oculosympathetic pathway** initiates pupillary **dilation**, allowing more light to reach the retina. Under bright light, parasympathetic input from the ipsilateral oculomotor nerve (CN III) initiates pupillary constriction, limiting the amount of light received by the retina.

Determining which pathway is affected in anisocoria can be accomplished by observing the change in pupillary discrepancy in both bright and dim light:

- Asymmetry that increases in dim light indicates that the smaller pupil is unable to dilate (ie, miosis) due to loss of sympathetic nerve input. Under bright light, the asymmetry will decrease because parasympathetic input (pupillary constriction) is unaffected.
- Asymmetry that increases under bright light indicates that the larger pupil is unable to constrict (ie, mydriasis) due to loss of parasympathetic nerve input. In dim light, the asymmetry will decrease because sympathetic input (pupillary dilation) is unaffected.

This patient has **increased asymmetry** in a **dim room**, indicating that the smaller (right) pupil is unable to dilate due to loss of sympathetic nerve input secondary to a **lesion** in the **right oculosympathetic pathway**.





pathway.

(Choices A and D) An oculomotor nerve lesion would disrupt parasympathetic innervation of the ipsilateral pupil, resulting in anisocoria that increases under bright light because the abnormal larger pupil is unable to constrict in response to light.

(Choice B) Damage to the left oculosympathetic pathway would cause loss of sympathetic input to the left eye, resulting in a fixed, constricted pupil in the left eye (with increased asymmetry in dim light) rather than in the right.

(Choices C and F) The optic nerves carry the **afferent portions** of the pupillary reflex from each eye. A unilateral optic nerve lesion would not cause pupillary asymmetry, but instead monocular vision loss and decreased bilateral pupillary constriction in response to light entering the affected eye (ie, **relative afferent pupillary defect**).

Educational objective:

Pupillary asymmetry (ie, anisocoria) is caused by a lesion in the ocular parasympathetic (pupillary constriction) or sympathetic (pupillary dilation) pathways. In this patient, the pupillary asymmetry increases in a dim room, indicating that the smaller right pupil is unable to dilate due to a lesion in the right oculosympathetic pathway.





Item 7 of 27

Question Id: 16172



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom

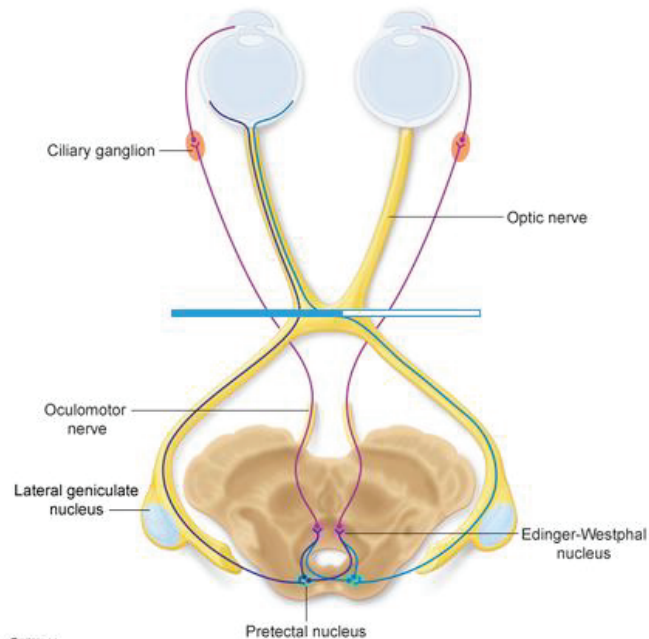


Settings

pathway

Exhibit Display

Pupillary light reflex



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Zoom In



Zoom Out



Reset



New | Existing



My Notebook

Block Time Remaining: 00:08:03

TUTOR

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1



Feedback



Suspend



End Block



A 3-month-old boy is brought to the office by his mother for a routine checkup. He is found to have a right-sided white pupillary reflex. His father was diagnosed with a retinal neoplasm during childhood and had his left eye enucleated. This child is at the greatest risk of developing which of the following neoplasms?

- ☐ A. Acute lymphoblastic leukemia
- ☐ B. Neuroblastoma
- ☐ C. Ewing sarcoma
- ☐ D. Osteosarcoma
- ☐ E. Medulloblastoma

Submit





A 3-month-old boy is brought to the office by his mother for a routine checkup. He is found to have a right-sided **white pupillary reflex**. His father was diagnosed with a **retinal neoplasm** during **childhood** and had his left eye enucleated. This child is at the greatest risk of developing which of the following neoplasms?

- ☐ A. Acute lymphoblastic leukemia (2%)
- ☐ B. Neuroblastoma (22%)
- ☐ C. Ewing sarcoma (5%)
- ☒ D. Osteosarcoma (62%)
- ☐ E. Medulloblastoma (6%)

Correct



62%
Answered correctly



40 secs
Time Spent



10/03/2020
Last Updated

Explanation



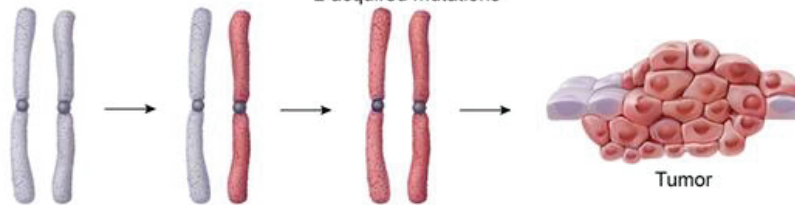


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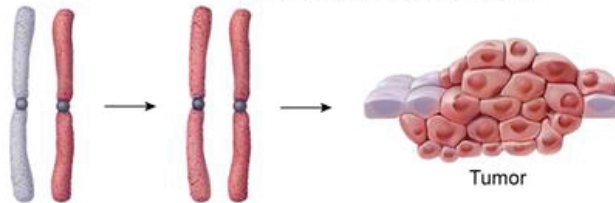
Knudson's 2-hit hypothesis

Both copies of the gene must be knocked out to promote malignancy.

Sporadic cancer:
2 acquired mutations



Hereditary cancer:
1 inherited and 1 acquired mutation



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Zoom In



Zoom Out



Reset



New | Existing



My Notebook



Retinoblastoma is the most common ocular tumor of childhood. It usually presents with a white pupillary reflex (**leukocoria**) in children <5 years old. Approximately 60% of retinoblastomas are sporadic (usually unilateral), while **40% are familial** (often, but not always, bilateral).

Familial retinoblastoma occurs due to a **germline mutation** that affects the **Rb tumor suppressor gene** on chromosome 13; affected children carry one copy of the mutation in all their cells. However, there are two copies of the Rb gene (one allele from each parent), and malignancy does not occur while at least one copy of the gene is still functional. A somatic second mutation acquired early in life is the "**second hit**" that leads to retinoblastoma, as cells with **two inactivated Rb genes** proliferate uncontrollably and give rise to **malignancy**.

Children with familial retinoblastoma often acquire other "second hit" mutations later in life, leading to additional tumors, usually sarcomas such as **osteosarcoma**. In contrast, patients with sporadic retinoblastoma are not at risk for other malignancies, as the chance of two acquired somatic mutations occurring multiple times in different cell lineages is very low.

(Choice A) Patients with Down syndrome, ataxia-telangiectasia, and neurofibromatosis type 1 have an increased risk of development of acute lymphoblastic leukemia, which is not associated with familial retinoblastoma.



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Children with familial retinoblastoma often acquire other "second hit" mutations later in life, leading to additional tumors, usually sarcomas such as **osteosarcoma**. In contrast, patients with sporadic retinoblastoma are not at risk for other malignancies, as the chance of two acquired somatic mutations occurring multiple times in different cell lineages is very low.

(Choice A) Patients with Down syndrome, ataxia-telangiectasia, and neurofibromatosis type 1 have an increased risk of development of acute lymphoblastic leukemia, which is not associated with familial retinoblastoma.





Item 8 of 27

Question Id: 863



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



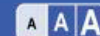
Notes



Calculator



Reverse Color



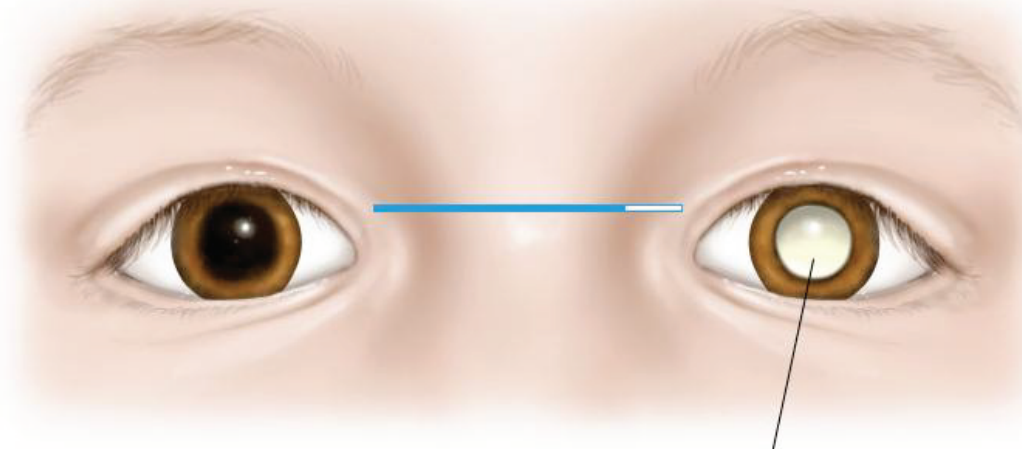
Text Zoom



Settings

Exhibit Display

Retinoblastoma white reflex



Retinoblastoma of the left eye with white reflex

USMLEWorld LLC



Zoom In



Zoom Out



Reset



New



Existing



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Block Time Remaining: 00:08:43

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Feedback



Suspend



End Block

(Choice A) Patients with Down syndrome, ataxia-telangiectasia, and neurofibromatosis type 1 have an increased risk of development of acute lymphoblastic leukemia, which is not associated with familial retinoblastoma.

(Choice B) Neuroblastoma is a common childhood cancer that arises from sympathetic nervous tissue, most commonly in the adrenals. Most cases are sporadic.

(Choice C) Ewing sarcoma is an undifferentiated neoplasm of mesenchymal origin that most commonly occurs in the long and flat bones of children and adolescents. It occurs sporadically.

(Choice E) Medulloblastoma is the most common *malignant* brain tumor of childhood, typically arising in the cerebellum.

Educational objective:

Familial retinoblastoma occurs as a result of mutations of each of the two Rb genes ("two hits"). These patients have an increased risk of secondary tumors, especially osteosarcomas, later in life.

Pathology

Ophthalmology

Retinoblastoma

Subject

System

Topic

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Physical examination of a 23-year-old man diagnosed with chronic hepatitis shows corneal changes that are visible to the naked eye, as shown in the image below.





This patient is most likely to have which of the following conditions?

- ☐ A. Pulmonary emphysema
- ☐ B. Diabetes mellitus
- ☐ C. Basal ganglia atrophy
- ☐ D. Renal cancer
- ☐ E. Hypertrophic cardiomyopathy
- ☐ F. Congenital deafness





This patient is most likely to have which of the following conditions?

- ☐ A. Pulmonary emphysema (2%)
- ☐ B. Diabetes mellitus (14%)
- ☒ C. Basal ganglia atrophy (68%)
- ☐ D. Renal cancer (3%)
- ☐ E. Hypertrophic cardiomyopathy (7%)
- ☐ F. Congenital deafness (3%)

Correct

68%
Answered correctly

42 secs
Time spent

10/08/2020
Last updated

Block Time Remaining: 00:09:25

TUTOR

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Feedback



Suspend



End Block



The image demonstrates a Kayser-Fleischer ring, an ophthalmologic finding most strongly associated with Wilson's disease (although it can also be seen in chronic cholestatic diseases such as primary biliary cirrhosis). Kayser-Fleischer rings are best identified on slit-lamp examination, but they can be observed grossly, especially with long-standing, untreated disease. The rings are formed through the granular deposition of copper within Descemet's membrane in the cornea.

Wilson's disease is a rare, autosomal recessive disease most often identified in individuals 5-40 years old. The genetic mutations associated with Wilson's disease hinder copper metabolism by reducing the formation and secretion of ceruloplasmin and decreasing hepatic secretion of copper into the biliary system. Copper is a pro-oxidant and causes damage to hepatic tissue through the generation of free radicals. Eventually, it leaks from injured hepatocytes into the circulation to be deposited in various tissues, including the cornea and basal ganglia. Atrophy of the basal ganglia then ensues.

Treatment is life-long and focuses on removing accumulated copper in the tissues and preventing its re-accumulation. First-line medications include copper chelators such as d-penicillamine and trientine.

(Choice A) Pulmonary emphysema commonly develops in patients with alpha-1 antitrypsin deficiency.

(Choice B) Diabetes mellitus commonly develops in patients with advanced hemochromatosis. It has no association with Wilson's disease.





(Choice A) Pulmonary emphysema commonly develops in patients with alpha-1 antitrypsin deficiency.

(Choice B) Diabetes mellitus commonly develops in patients with advanced hemochromatosis. It has no association with Wilson's disease.

(Choice D) Renal cancer (clear cell carcinoma) occurs more frequently in patients with von Hippel-Lindau disease, not Wilson's disease.

(Choice E) Hypertrophic cardiomyopathy presenting in childhood and adolescence is an autosomal dominant disease involving the cardiac sarcomere. It is not associated with Wilson's disease.

(Choice F) Congenital deafness can develop secondary to numerous hereditary and nonhereditary conditions. Wilson's disease has no association with congenital deafness.

Educational objective:

The Kayser-Fleischer ring is an ophthalmologic finding most strongly associated with Wilson's disease. It is seen most frequently in patients with neuropsychiatric complications. Basal ganglia atrophy is typically present in these patients.

Pathology

Ophthalmology

Wilson disease

Subject

System

Topic





A 68-year-old woman is evaluated for vision impairment. The patient has a decrease in both distant and near vision and has had occasional floaters. She has had no pain or redness in her eyes, headache, focal weakness, or sensory loss. Medical history is notable for type 2 diabetes mellitus, hypertension, and chronic kidney disease. Blood pressure is 138/84 mm Hg and pulse is 76/min. The pupils are equal and reactive to light bilaterally. Anterior chambers are clear, and there are no opacities of the cornea or lens. Fundusoscopic examination reveals scattered retinal microaneurysms, dot-and-blot hemorrhages, and cotton-wool spots, as well as new blood vessel formation. Which of the following contributed most to the pathogenesis of this patient's current ocular condition?

- ☐ A. Age-related degeneration of retinal pigment epithelium
- ☐ B. Chronic hyperglycemia-induced microvascular injury
- ☐ C. Ganglion cell death due to high intraocular pressure
- ☐ D. Retinal arterial occlusion from atherosclerotic disease
- ☐ E. Vascular injury from increased intraluminal pressure





near vision and has had occasional floaters. She has had no pain or redness in her eyes, headache, focal weakness, or sensory loss. Medical history is notable for type 2 diabetes mellitus, hypertension, and chronic kidney disease. Blood pressure is 138/84 mm Hg and pulse is 76/min. The pupils are equal and reactive to light bilaterally. Anterior chambers are clear, and there are no opacities of the cornea or lens. Fundusoscopic examination reveals scattered retinal microaneurysms, dot-and-blot hemorrhages, and cotton-wool spots, as well as new blood vessel formation. Which of the following contributed most to the pathogenesis of this patient's current ocular condition?

- ☐ A. Age-related degeneration of retinal pigment epithelium (3%)
- ☒ B. Chronic hyperglycemia-induced microvascular injury (72%)
- ☐ C. Ganglion cell death due to high intraocular pressure (0%)
- ☐ D. Retinal arterial occlusion from atherosclerotic disease (6%)
- ☐ E. Vascular injury from increased intraluminal pressure (16%)

Correct

72%



01 min, 35 secs



02/13/2021





Item 10 of 27

Question Id: 15668



Mark

Previous

Next

Full Screen

Tutorial

Lab Values

Notes

Calculator

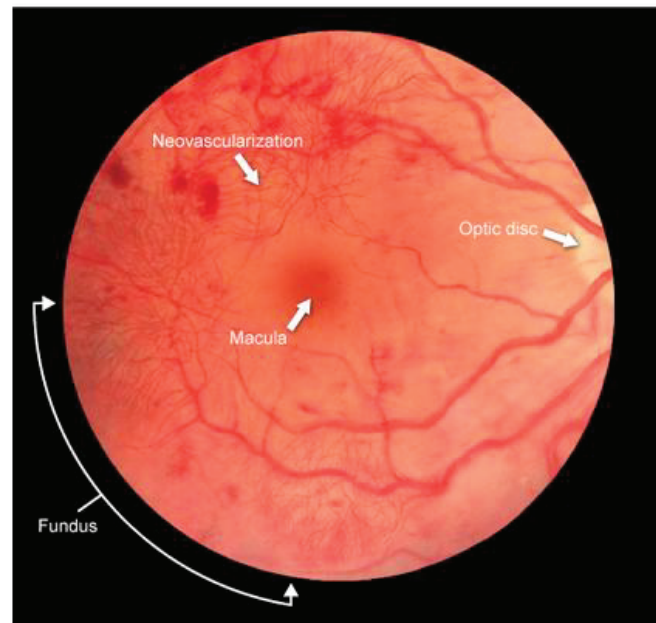
Reverse Color

Text Zoom

Settings

Exhibit Display

Diabetic retinopathy, proliferative (PDR)



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Zoom In



Zoom Out



Reset



New | Existing



My Notebook

Block Time Remaining: 00:11:00

TUTOR

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Feedback



Suspend



End Block

This patient, with painless vision loss and retinal neovascularization, has proliferative **diabetic retinopathy** (DR). DR is a result of chronic hyperglycemic injury to the small retinal vessels and is considered a **microangiopathic** complication of diabetes (along with neuropathy and nephropathy). The prevalence of DR is proportionate to the duration of diabetes and severity of hyperglycemia over time; tight control of diabetes is associated with a lower long-term risk of DR.

DR is categorized as follows:

- **Nonproliferative** (early disease): The earliest morphologic changes include thickening of the basement membrane and failure of the blood-retinal barrier. Increased permeability allows leakage of fluid into the retina (macular edema), which can distort vision and leave behind lipid-rich deposits (hard exudates). Arteriolar obstruction causes ischemic injury to the retina, which manifests as **cotton-wool spots**. Other findings include **microaneurysms** and dot-blot hemorrhages (due to microaneurysm rupture).
- **Proliferative** (advanced disease): Progressive retinal ischemia stimulates production of angiogenic factors (eg, vascular endothelial growth factor), leading to formation of new retinal vessels (**neovascularization**). The new vessels are fragile and often extend into the adjacent vitreous. Traction from the vitreous can cause detachment of the retina or laceration of the vessels, leading to



Item 10 of 27

Question Id: 15668



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Previous

Next

Full Screen

Tutorial

Lab Values

Notes

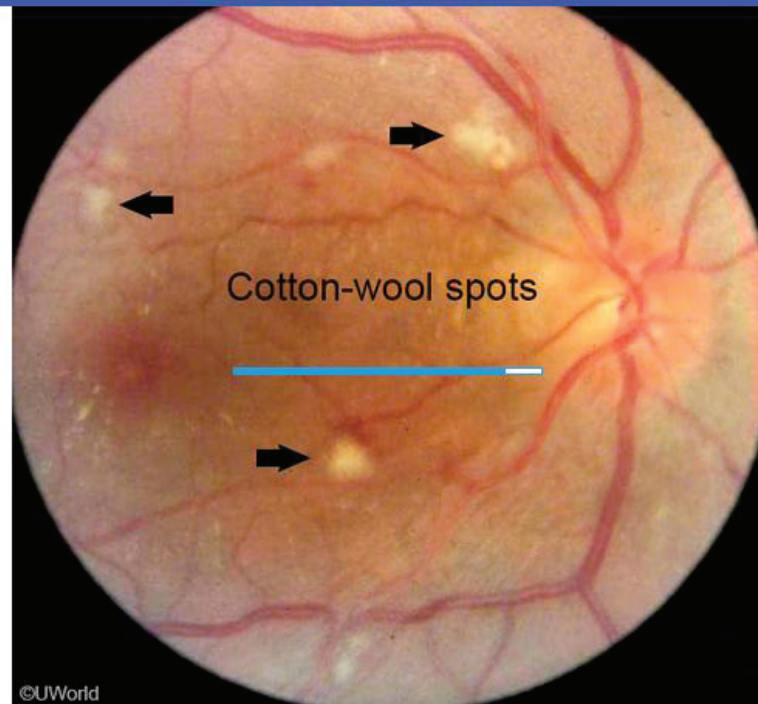
Calculator

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Zoom In



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My Notebook

Traction from the vitreous can cause detachment of the retina or laceration of the vessels, leading to

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End Block



Item 10 of 27

Question Id: 15668



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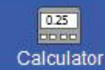
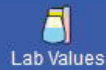
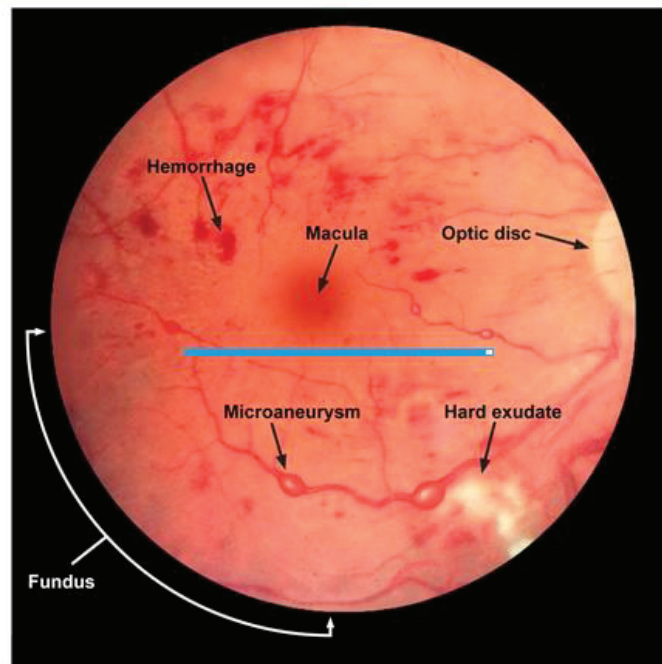


Exhibit Display



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My Notebook

Traction from the vitreous can cause detachment of the retina or laceration of the vessels, leading to

Block Time Remaining: 00:11:00

TUTOR

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Feedback



Suspend



End Block



rupture).

- **Proliferative** (advanced disease): Progressive retinal ischemia stimulates production of angiogenic factors (eg, vascular endothelial growth factor), leading to formation of new retinal vessels (**neovascularization**). The new vessels are fragile and often extend into the adjacent vitreous. Traction from the vitreous can cause detachment of the retina or laceration of the vessels, leading to acute hemorrhage and vision loss.

(Choice A) Age-related macular degeneration presents with slowly progressive *central vision* loss. It is due to oxidative damage to the pigment epithelium and choriocapillaris with abnormal extracellular matrix formation (drusen). In late-stage disease, patients may develop neovascularization ("wet" macular degeneration), but associated findings include subretinal **drusen** and pigment abnormalities.

(Choice C) Open-angle glaucoma is a form of optic neuropathy, characterized by ganglion cell death in association with elevated intraocular pressure. It causes insidious loss of *peripheral vision*; examination findings include **enlargement of the retinal cup** and a pale optic disc with thinning of the rim.

(Choice D) Atheroembolic retinal artery occlusion presents with acute *monocular* vision loss. Examination findings include retinal pallor and a **cherry red spot** at the macula.

(Choice E) Hypertensive retinopathy can manifest with retinal hemorrhages, cotton-wool spots, and hard





Item 10 of 27

Question Id: 15668



Mark

Previous

Next

Full Screen

Tutorial

Lab Values

Notes

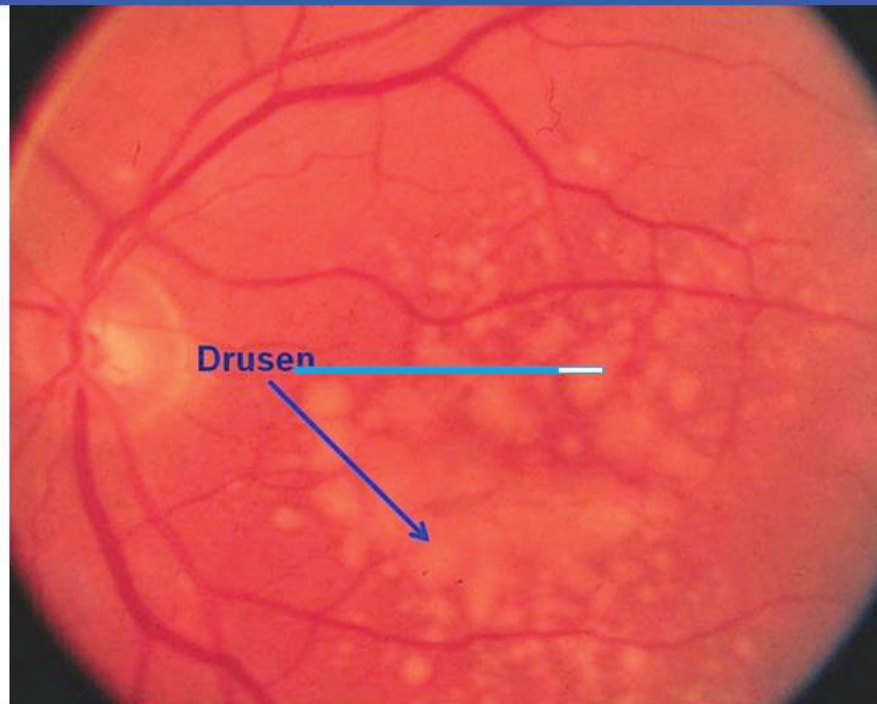
Calculator

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Exhibit Display



Zoom In



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My Notebook

(Choice E) Hypertensive retinopathy can manifest with retinal hemorrhages, cotton-wool spots, and hard

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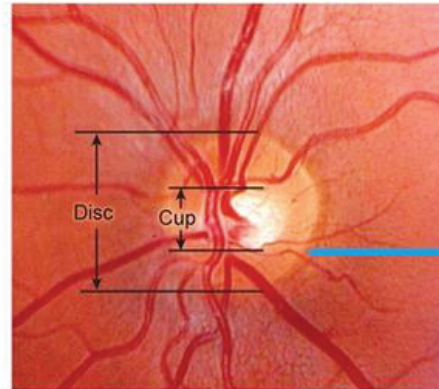
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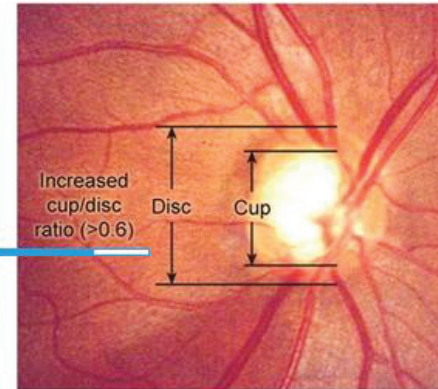
Optic disc in glaucoma

Normal



- Cup/disc ratio < 0.5
- Clear disc rim

Open-angle glaucoma



- Enlarged cup with cup/disc ratio > 0.6
- Increase in cup size over time
- Thinning of disc rim
- Pale disc (optic nerve atrophy)

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My Notebook

(Choice E) Hypertensive retinopathy can manifest with retinal hemorrhages, cotton-wool spots, and hard

Block Time Remaining: 00:11:00

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Feedback



Suspend



End Block



Item 10 of 27

Question Id: 15668



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



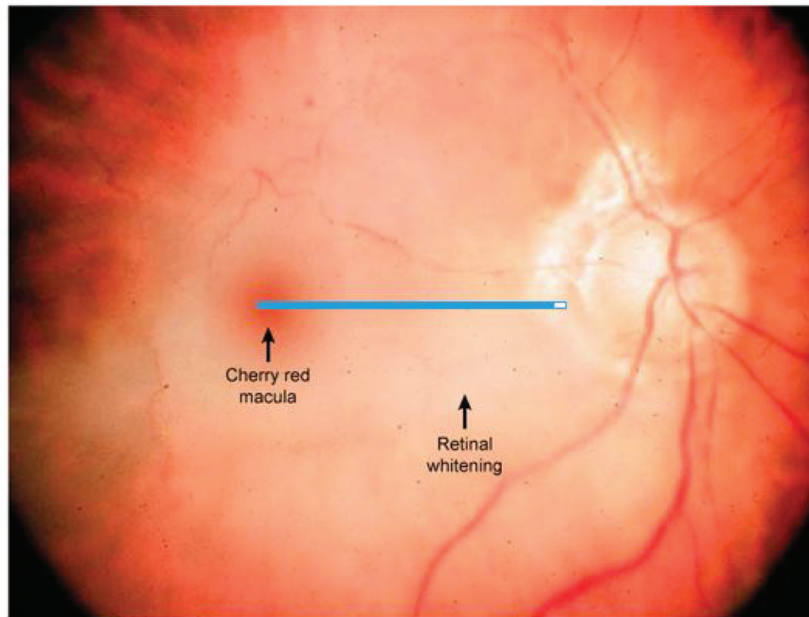
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Central retinal artery occlusion



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Zoom Out



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My Notebook

(Choice E) Hypertensive retinopathy can manifest with retinal hemorrhages, cotton-wool spots, and hard

Block Time Remaining: 00:11:00

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Feedback



Suspend



End Block

(Choice C) Open-angle glaucoma is a form of optic neuropathy, characterized by ganglion cell death in association with elevated intraocular pressure. It causes insidious loss of *peripheral vision*; examination findings include **enlargement of the retinal cup** and a pale optic disc with thinning of the rim.

(Choice D) Atheroembolic retinal artery occlusion presents with acute *monocular* vision loss. Examination findings include retinal pallor and a **cherry red spot** at the macula.

(Choice E) Hypertensive retinopathy can manifest with retinal hemorrhages, cotton-wool spots, and hard exudates. However, the thickened and stiffened arterial walls are typically visible as **arteriolar narrowing** and impingement on the veins where they are crossed by arteries (arteriovenous nicking).

Educational objective:

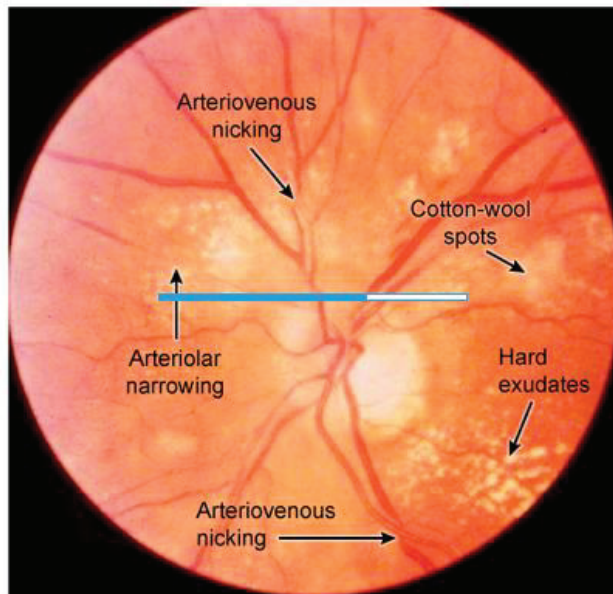
Chronic hyperglycemia in patients with diabetes can lead to increased permeability and arteriolar obstruction in retinal vessels. The resulting ischemia stimulates production of vascular endothelial growth factor and other angiogenic factors, leading to neovascularization (proliferative diabetic retinopathy). Complications include retinal hemorrhage, retinal detachment, and vision loss.

Pathology	Ophthalmology	Diabetic retinopathy
Subject	System	Topic



Exhibit Display

Hypertensive retinopathy



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A male neonate is born prematurely to 22-year-old primigravida and experiences severe respiratory distress. The distress resolves with treatment, and by two weeks of age, the patient has adequate respiratory function. Ophthalmoscopy later shows abnormal retinal vascularization that extends into the vitreous. The retinal findings in this patient are most likely related to:

- ☐ A. Maternal terbutaline treatment
- ☐ B. Maternal corticosteroid therapy
- ☐ C. Neonatal antibiotic treatment
- ☐ D. Neonatal oxygen supplementation
- ☐ E. Neonatal surfactant supplementation

Submit



A male neonate is born **prematurely** to 22-year-old primigravida and experiences severe respiratory distress. The distress resolves with treatment, and by two weeks of age, the patient has adequate respiratory function. Ophthalmoscopy later shows **abnormal retinal vascularization** that extends into the vitreous. The retinal findings in this patient are most likely related to:

- ☐ A. Maternal terbutaline treatment (2%)
- ☐ B. Maternal corticosteroid therapy (9%)
- ☐ C. Neonatal antibiotic treatment (2%)
- ☒ D. Neonatal oxygen supplementation (76%)
- ☐ E. Neonatal surfactant supplementation (8%)

Correct

 76%
Answered correctly

 35 secs
Time Spent

 01/30/2021
Last Updated





Respiratory distress in a premature neonate is most commonly due to pulmonary surfactant deficiency resulting in hyaline membrane disease. Treatment involves administration of supplemental oxygen at high concentrations, nasal continuous positive airway pressure, and/or mechanical ventilation with intratracheal surfactant. One potential adverse effect of oxygen therapy is retinal damage.

Temporary local hyperoxia in the retina is thought to induce changes that cause up-regulation of proangiogenic factors such as vascular endothelial growth factor (VEGF) upon return to room air ventilation. Retinal vessel proliferation (*neovascularization*) and possible retinal detachment with blindness may result. This complication of neonatal respiratory distress syndrome is referred to as retinopathy of prematurity or retrolental fibroplasia.

(Choice A) Terbutaline is a β -mimetic tocolytic drug used to delay labor and delivery by suppressing uterine contractions. Use of terbutaline has been linked to an increased risk of neonatal intraventricular hemorrhage, hypoglycemia, hypocalcemia, and ileus.

(Choice B) Corticosteroids may be administered to pregnant women entering premature labor in an effort to induce surfactant production by the fetal lungs. Maternal steroid treatment in the prenatal period does not cause neonatal retinal neovascularization.





hemorrhage, hypoglycemia, hypocalcemia, and ileus.

(Choice B) Corticosteroids may be administered to pregnant women entering premature labor in an effort to induce surfactant production by the fetal lungs. Maternal steroid treatment in the prenatal period does not cause neonatal retinal neovascularization.

(Choice C) Neonatal antibiotic treatment does not cause retinal neovascularization.

(Choice E) Complications of surfactant treatment may include transient hypoxia and hypotension, blockage of an endotracheal tube, and pulmonary hemorrhage. Retinal neovascularization is not a known complication.

Educational Objective:

Use of concentrated oxygen therapy for neonatal respiratory distress syndrome may be complicated by retinopathy of prematurity. This abnormal retinal neovascularization is a major cause of blindness in developed nations.

Pathology

Ophthalmology

Neonatal respiratory distress syndrome

Subject

System

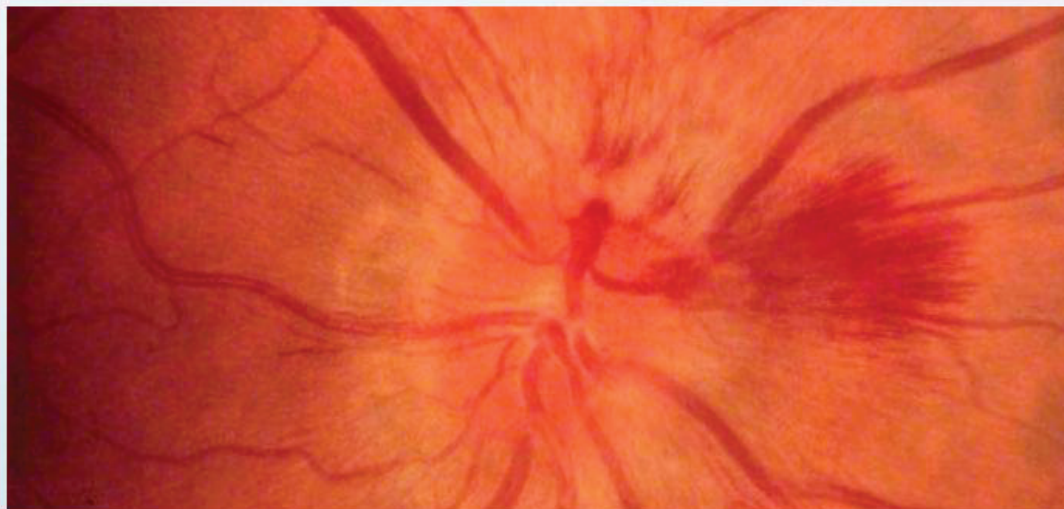
Topic

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A 62-year-old man with a history of poor medical follow-up comes to the office due to difficulty seeing. He has had blurry vision for the last 2 weeks. A day ago, he noticed a shadow develop suddenly across the visual field of his right eye. The patient has had no recent headaches, double vision, vertigo, light sensitivity, or nausea. On examination, pupils are equal and reactive to light. Visual field testing by confrontation reveals patchy loss of vision. A flame-shaped retinal hemorrhage in the right eye is noted on fundusoscopic examination, as shown in the image below.





Item 12 of 27

Question Id: 11675



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



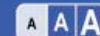
Notes



Calculator



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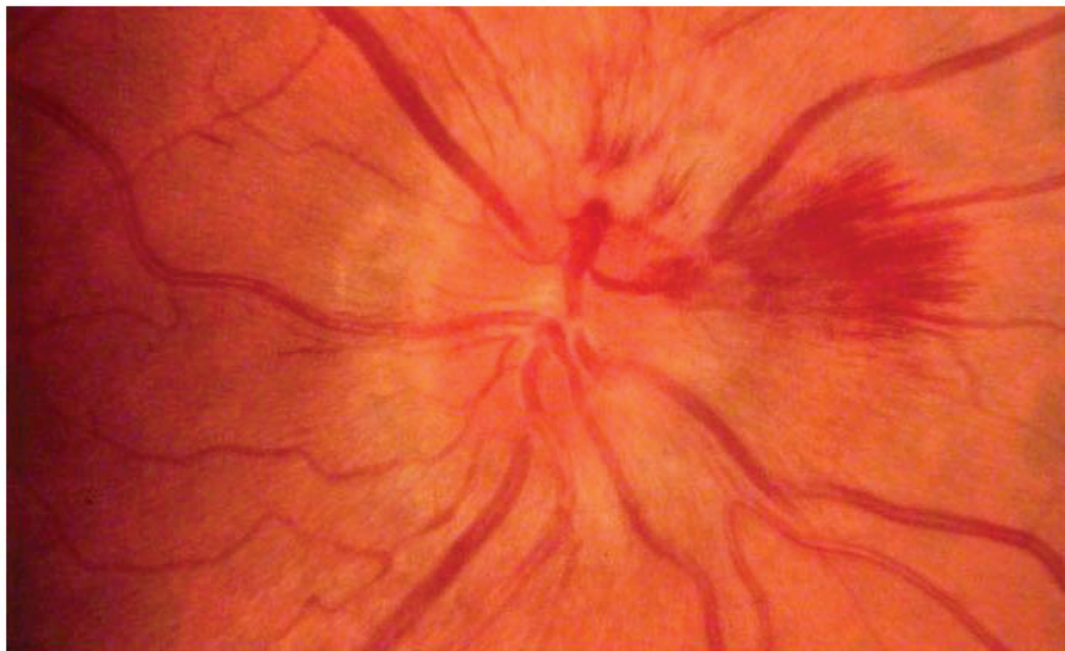


Text Zoom



Settings

Exhibit Display



Zoom In



Zoom Out



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My Notebook

Block Time Remaining: 00:11:39

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Feedback



Suspend



End Block



Which of the following is the most likely cause of his visual disturbance?

- ☐ A. Central retinal artery occlusion
- ☐ B. Cigarette smoking
- ☐ C. Closed-angle glaucoma
- ☐ D. Giant cell arteritis
- ☐ E. Hyperlipidemia
- ☐ F. Hypertension
- ☐ G. Migraine
- ☐ H. Thyroid eye disease

Submit





Which of the following is the most likely cause of his visual disturbance?

- ☐ A. Central retinal artery occlusion (18%)
- ☐ B. Cigarette smoking (4%)
- ☐ C. Closed-angle glaucoma (4%)
- ☐ D. Giant cell arteritis (3%)
- ☐ E. Hyperlipidemia (3%)
- ☒ F. Hypertension (66%)
- ☐ G. Migraine (0%)
- ☐ H. Thyroid eye disease (0%)

Correct

66%
Answered correctly

54 secs
Time spent

11/28/2020
Last Updated





Item 12 of 27

Question Id: 11675



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



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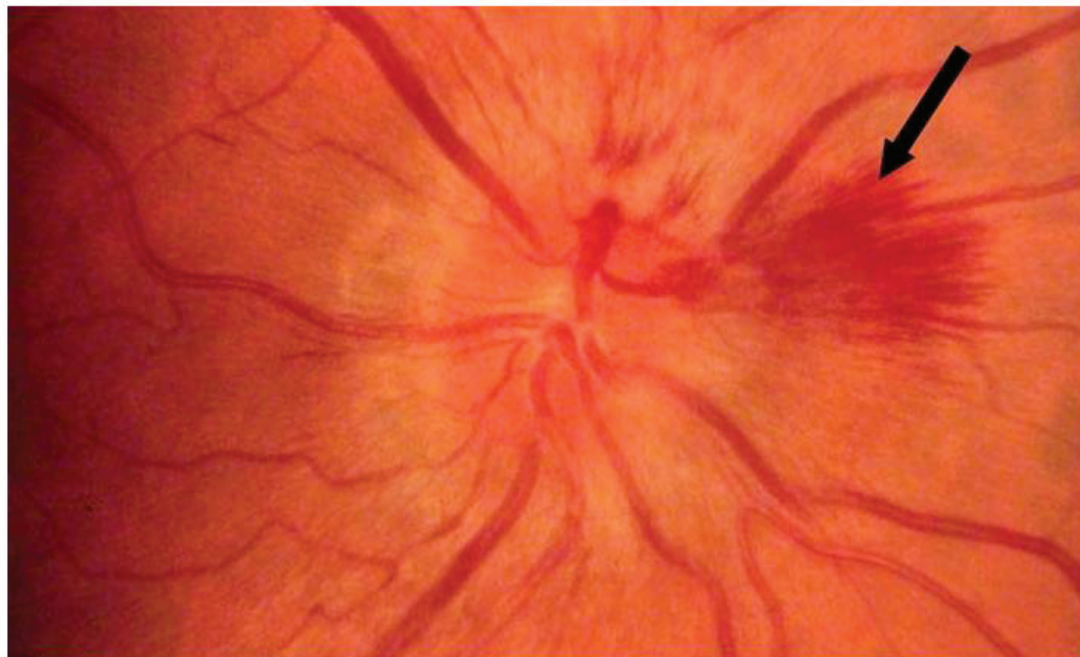


Text Zoom



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Block Time Remaining: 00:12:29

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This patient has an acute retinal hemorrhage (arrow), most likely caused by severe, poorly controlled **hypertension**. Hypertensive retinal hemorrhage typically causes painless, unilateral visual disturbances, ranging from mild obscuration without loss of visual acuity to permanent blindness. Severe hypertension in retinal precapillary arterioles causes endothelial disruption, leakage of plasma into the arteriolar wall, and **fibrinous necrosis**. The necrotic vessels can then bleed into the nerve fiber layers, causing dot- and flame-shaped hemorrhages.

Diagnosis of hypertensive retinal hemorrhage is usually confirmed by direct ophthalmoscopic evaluation. Other findings of hypertensive retinopathy include thickening of the arteriolar walls ("copper or silver wiring"), compression of the associated veins (arteriovenous nicking), and small, white foci of retinal ischemia ([cotton-wool spots](#)).

(Choices A and D) Central retinal artery occlusion is most commonly due to atherosclerosis, cardioembolic disease, or vasculitis (eg, giant cell arteritis). It causes acute monocular vision loss. Examination can reveal a [cherry red spot](#) at the macula due to diffuse retinal ischemia, but hemorrhage is not typically seen.

(Choices B and E) Smoking and hyperlipidemia can increase the risk of developing ischemic retinal and





Item 12 of 27

Question Id: 11675



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color

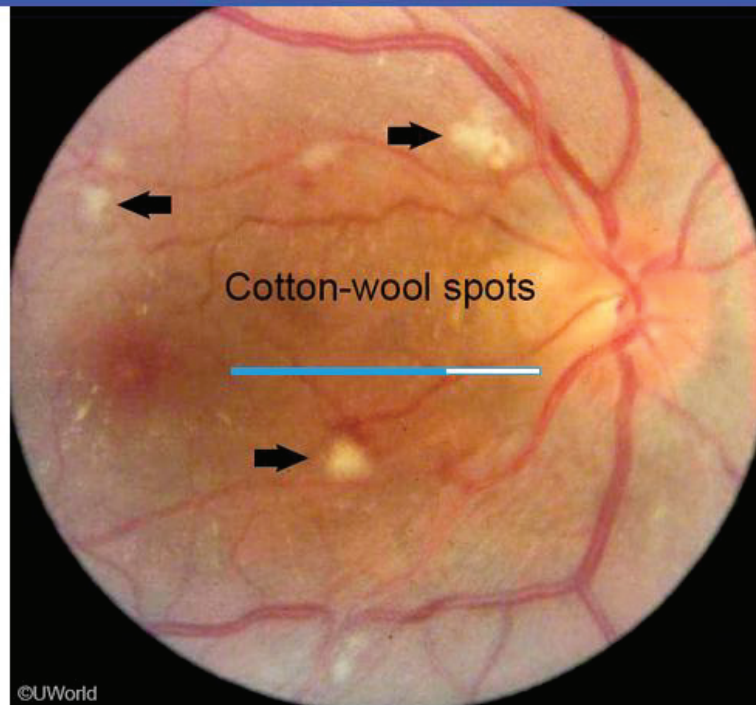


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Exhibit Display



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Zoom Out



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My Notebook

(Choices B and E) Smoking and hyperlipidemia can increase the risk of developing ischemic retinal and

Block Time Remaining: 00:12:29

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Feedback



Suspend



End Block



Item 12 of 27

Question Id: 11675



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



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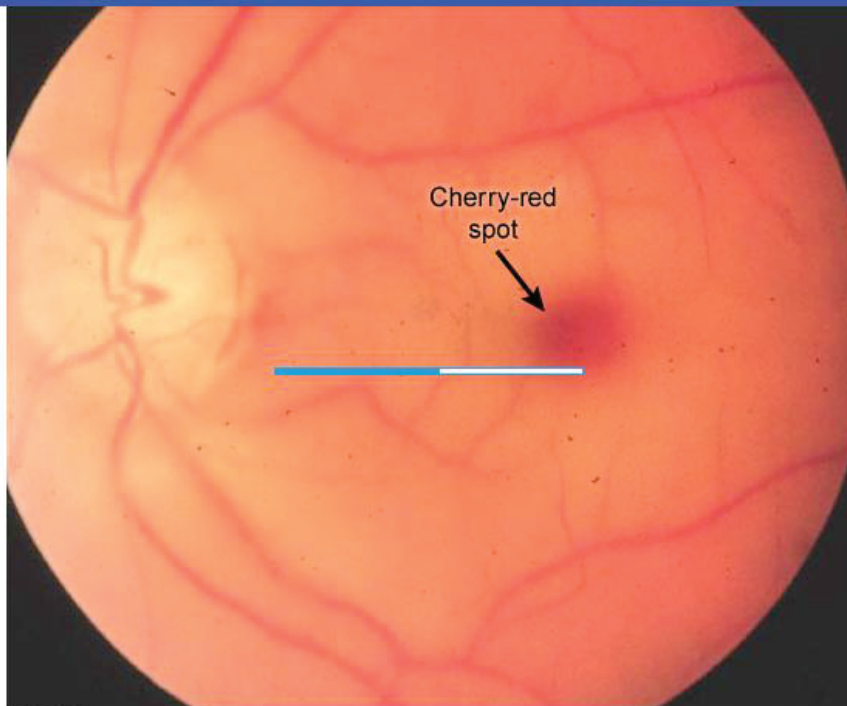


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My Notebook

Block Time Remaining: 00:12:29

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Feedback



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End Block

(Choices B and E) Smoking and hyperlipidemia can increase the risk of developing ischemic retinal and optic vascular disease; however, these are not associated with an increased risk of retinal hemorrhage.

(Choice C) Closed-angle glaucoma is characterized by increased intraocular pressure from impaired aqueous humor drainage. It causes acute headache, eye pain, vision loss, and an afferent pupillary defect. Ophthalmoscopic examination reveals **cupping** of the optic disc without hemorrhage.

(Choice G) Ocular migraine and migraine with visual aura can present with transient visual disturbances, with or without headache. Ophthalmoscopic examination is normal in patients with migraine.

(Choice H) Thyroid eye disease (eg, Graves disease) can present with diplopia and proptosis; however, it is not associated with an increased risk of retinal hemorrhage.

Educational objective:

Severe hypertension in retinal precapillary arterioles causes endothelial disruption, leakage of plasma into the arteriolar wall, and fibrinous necrosis. The necrotic vessels can then bleed into the nerve fiber layer, which can be seen on examination as dot- or flame-shaped hemorrhages.

Pathology	Ophthalmology	Hypertensive retinopathy
Subject	System	Topic



Item 12 of 27

Question Id: 11675



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



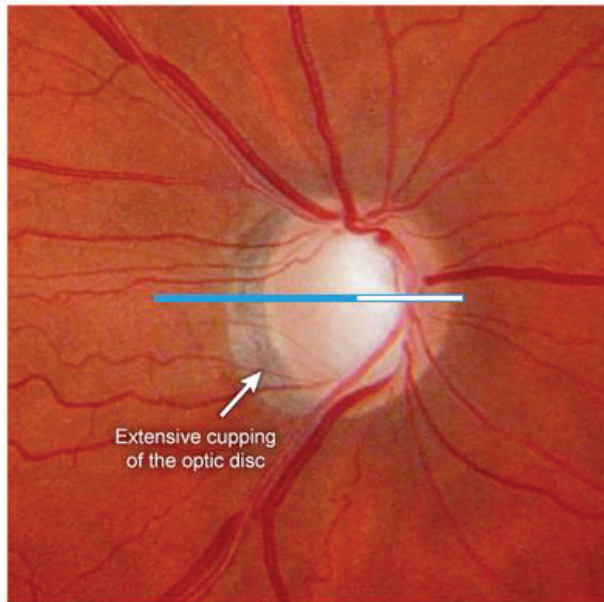
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Glaucomatous optic atrophy (advanced)



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Zoom In



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Block Time Remaining: 00:12:29

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Suspend



End Block



A 45-year-old woman comes to the office due to progressive visual difficulty with night driving and reading road signs and fine print. The patient has systemic lupus erythematosus, which is treated with hydroxychloroquine and prednisone. She avoids sun exposure due to photosensitivity and has vitamin D deficiency for which she takes a vitamin D supplement. Examination shows opacities on the posterior side of the lenses in both eyes. Optic discs are normal. Ocular movements are full. The remainder of the examination shows no abnormalities. Which of the following is the most significant contributing factor for the eye findings in this patient?

- ☐ A. Hydroxychloroquine
- ☐ B. Lack of sun exposure
- ☐ C. Prednisone
- ☐ D. Systemic lupus erythematosus
- ☐ E. Vitamin D deficiency

Submit



A 45-year-old woman comes to the office due to progressive visual difficulty with night driving and reading road signs and fine print. The patient has systemic lupus erythematosus, which is treated with hydroxychloroquine and prednisone. She avoids sun exposure due to photosensitivity and has vitamin D deficiency for which she takes a vitamin D supplement. Examination shows opacities on the posterior side of the lenses in both eyes. Optic discs are normal. Ocular movements are full. The remainder of the examination shows no abnormalities. Which of the following is the most significant contributing factor for the eye findings in this patient?

- ☐ A. Hydroxychloroquine (35%)
- ☐ B. Lack of sun exposure (2%)
- ☒ C. Prednisone (47%)
- ☐ D. Systemic lupus erythematosus (12%)
- ☐ E. Vitamin D deficiency (1%)





Cataracts	
Pathogenesis	<ul style="list-style-type: none">• Oxidative damage & opacification of the lens
Risk factors	<ul style="list-style-type: none">• Age >60• Diabetes mellitus• Chronic sunlight exposure• Tobacco use• Immunosuppression (eg, HIV, corticosteroids)
Clinical features	<ul style="list-style-type: none">• Painless, progressive, bilateral vision loss• Difficulty with nighttime driving• Loss of red reflex• Opacified lens
Treatment	<ul style="list-style-type: none">• Artificial lens implantation

This patient has bilateral **opacities in the ocular lenses**, findings consistent with cataracts. **Cataracts** can cause **difficulty with reading** and fine visual tasks; patients often see excessive **glare** at night and



This patient has bilateral **opacities in the ocular lenses**, findings consistent with cataracts. **Cataracts** can cause **difficulty with reading** and fine visual tasks; patients often see excessive **glare** at night and **halos** around bright lights due to light scattering in the lens. Examination findings include white or gray cloudiness of the lens, decreased visualization of retinal detail, and loss of the **red reflex**.

Cataracts are generally related to **chronic photooxidative injury**; the prevalence increases with age, and most patients with cataracts first develop symptoms at age >60. However, cataracts can develop earlier in individuals, such as this patient, with exposure to systemic or ocular **glucocorticoids** (eg, prednisone). This may be due to glucocorticoid-induced transcription of genes in the lens epithelial cell that may alter lens homeostasis or increase the susceptibility to oxidative injury. Other causes of premature cataract formation include diabetes mellitus, ocular trauma, and external radiation exposure.

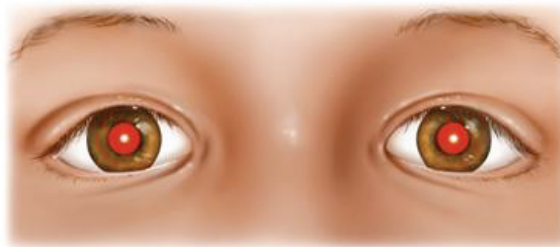
(Choices A and D) The increased risk of premature cataract formation in patients with systemic lupus erythematosus (SLE) is due primarily to chronic/frequent glucocorticoid exposure, not to the disease itself. Patients with SLE are often treated with hydroxychloroquine; long-term use can cause retinopathy, which presents with decreased central visual acuity, photopsia (flashing lights), and central macular degeneration.

(Choice B) Excessive, not limited, lifetime sun exposure is associated with an increased risk of cataracts.



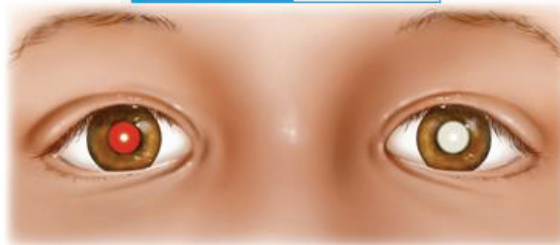
Exhibit Display

Normal eyes & white reflex



Normal eyes

Red reflexes & corneal light reflexes are equal.



Absent reflex

White reflex on abnormal eye can result from opacities of the lens (eg, cataract) or tumor (eg, retinoblastoma).

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New | Existing



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Patients with SLE are often treated with hydroxychloroquine; long-term use can cause retinopathy, which presents with decreased central visual acuity, photopsia (flashing lights), and central macular degeneration.

(Choice B) Excessive, not limited, lifetime sun exposure is associated with an increased risk of cataracts.

(Choice E) Common manifestations of vitamin D deficiency include hypocalcemia, bone pain, and accelerated bone loss. Cataracts are not a major consequence of vitamin D deficiency.

Educational objective:

Cataracts are related primarily to chronic photooxidative injury. Most patients with cataracts first develop symptoms at age >60 but exposure to systemic or ophthalmic glucocorticoids can cause cataracts at an early age. Other causes of premature cataract formation include diabetes mellitus, ocular trauma, and external radiation exposure.

References

- [Risk factors for cataracts in systemic lupus erythematosus \(SLE\).](#)

Pharmacology

Ophthalmology

Corticosteroids

Subject

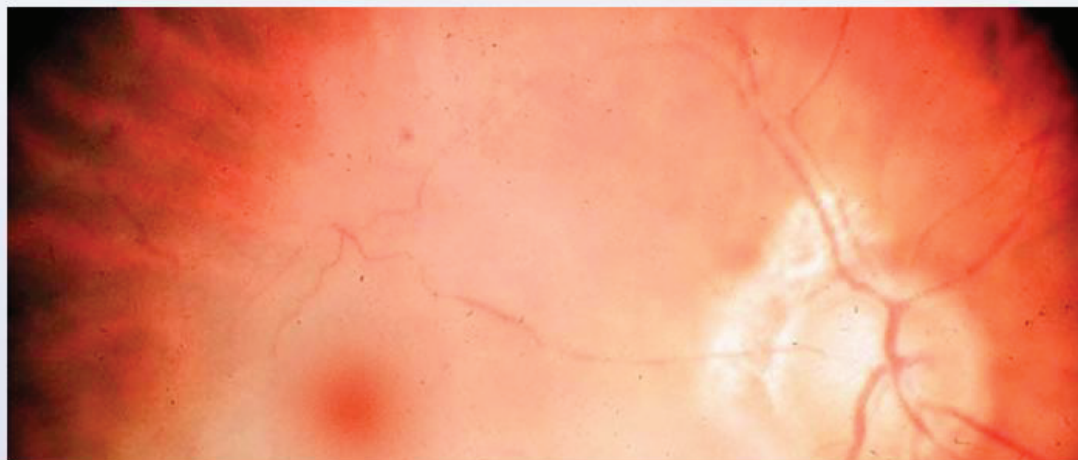
System

Topic

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A 64-year-old man comes to the emergency department due to painless loss of vision in the right eye. The patient's symptoms started suddenly several hours ago and have persisted. He has had no trauma or any similar episode in the past. He has a history of coronary artery disease, atrial fibrillation, and type 2 diabetes mellitus. Blood pressure is 144/86 mm Hg and pulse is 92/min. Cardiovascular examination reveals irregularly irregular rhythm with no murmurs, no peripheral edema, and slightly diminished pedal pulses in both feet symmetrically. Visual acuity in the right eye is hand motion only and normal in the left eye. Fundusoscopic examination of the right eye is shown in the image below.





Item 14 of 27

Question Id: 360



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



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Zoom In



Zoom Out



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Block Time Remaining: 00:13:23

TUTOR

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Feedback



Suspend



End Block



Which of the following is the most likely cause of this patient's loss of vision?

- ☐ A. Amaurosis fugax
- ☐ B. Diabetic retinopathy
- ☐ C. Pituitary adenoma
- ☐ D. Retinal artery occlusion
- ☐ E. Temporal lobe stroke

Submit





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Which of the following is the most likely cause of this patient's loss of vision?

- ☐ A. Amaurosis fugax (7%)
- ☐ B. Diabetic retinopathy (14%)
- ☐ C. Pituitary adenoma (0%)
- ☒ D. Retinal artery occlusion (76%)
- ☐ E. Temporal lobe stroke (1%)

Correct

76%



14 secs



01/18/2021

Block Time Remaining: 00:13:33

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Feedback



Suspend



End Block



Item 14 of 27

Question Id: 360



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



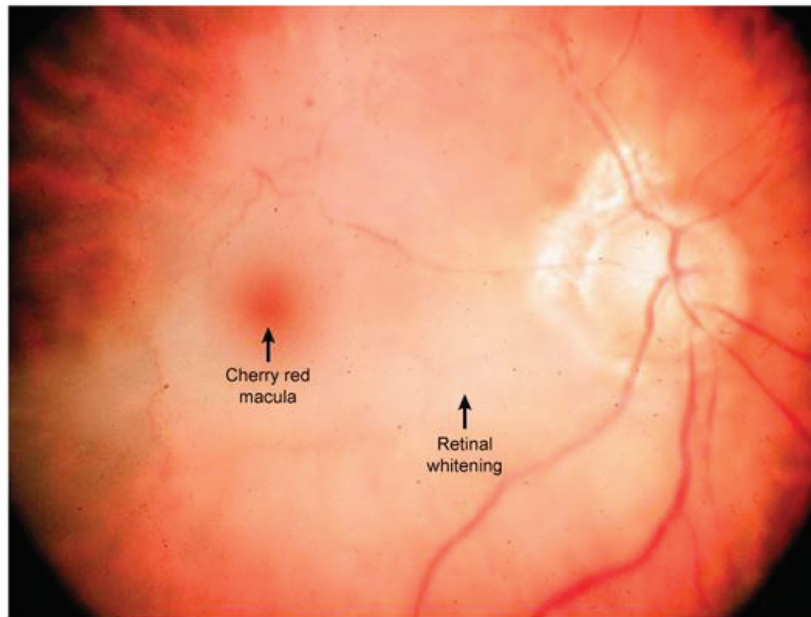
Text Zoom



Settings

Exhibit Display

Central retinal artery occlusion



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Zoom In



Zoom Out



Reset



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Block Time Remaining: 00:13:33

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Suspend



End Block



Acute and painless monocular vision loss is characteristic of **central retinal artery occlusion** (CRAO).

The vision loss includes the entire visual field and is often permanent. Funduscopic findings include a pale retina (due to ischemia and edema) and a **cherry-red macula** (the fovea and foveola are thin and have a separate blood supply from the choroid artery; the red choroid is easily visible underneath).

The central retinal artery is a branch of the ophthalmic artery, which arises from the internal carotid artery.

Athero- and thromboembolism are the most common causes of CRAO. Predisposing conditions include atrial fibrillation and carotid artery stenosis. CRAO may also be caused by vasculitic diseases (eg, giant cell arteritis).

(Choice A) Amaurosis fugax is a painless, transient, monocular vision loss caused by a small embolus to the ophthalmic artery. It usually does not last more than a few seconds.

(Choice B) Diabetic retinopathy manifests with blurry vision, black spots, floaters, and decreased peripheral vision. Acute visual loss may occur in the setting of a complication such as vitreous hemorrhage, but this patient does not have evidence of **neovascularization** or hemorrhage.

(Choice C) Large pituitary adenomas may compress the central part of the optic chiasm, causing bitemporal hemianopia.





Item 14 of 27

Question Id: 360



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



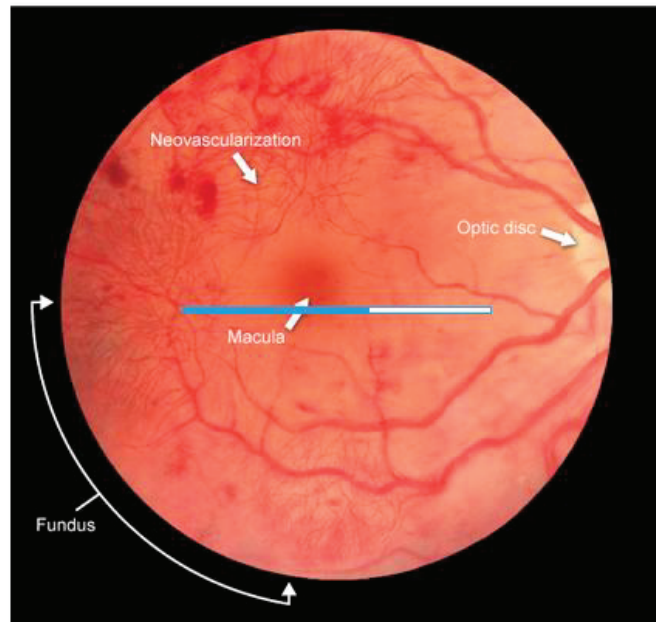
Text Zoom



Settings

Exhibit Display

Diabetic retinopathy, proliferative (PDR)



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Zoom In



Zoom Out



Reset



New | Existing



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Feedback



Suspend



End Block

the ophthalmic artery. It usually does not last more than a few seconds.

(Choice B) Diabetic retinopathy manifests with blurry vision, black spots, floaters, and decreased peripheral vision. Acute visual loss may occur in the setting of a complication such as vitreous hemorrhage, but this patient does not have evidence of **neovascularization** or hemorrhage.

(Choice C) Large pituitary adenomas may compress the central part of the optic chiasm, causing bitemporal hemianopia.

(Choice E) The lower division of the geniculocalcarine tract (Meyer loop), which carries impulses from the lower retina, passes through the temporal lobe. Temporal lobe infarcts involving the Meyer loop cause contralateral upper quadrantanopsia ("pie in the sky" visual defect).

Educational objective:

Central retinal artery occlusion presents with sudden, painless, and permanent monocular blindness. Funduscopic examination reveals a pale retina and a "cherry-red" macula.

References

- [A review of central retinal artery occlusion: clinical presentation and management.](#)

Pathophysiology Ophthalmology Retinal artery occlusion



A 75-year-old man comes to the office due to a 2-year history of slowly worsening vision in both eyes. The symptoms are worse at night and the patient has stopped driving at night due to excessive glare from oncoming headlights. He has worked his entire life as a farmer and continues to drive tractors and other farm equipment during the day without difficulty. Medical history is unremarkable. Ocular examination shows loss of the red reflex and poor visualization of retinal detail. Acuity testing shows 20/100 vision in both eyes; visual field testing is normal. Which of the following is the most likely etiologic factor for this patient's eye condition?

- ☐ A. Accumulation of sorbitol in the lens
- ☐ B. Age-related oxidative injury
- ☐ C. Decreased collagen fibril production
- ☐ D. Ischemia and neovascularization
- ☐ E. Loss of lens distensibility

Submit





A 75-year-old man comes to the office due to a 2-year history of slowly worsening vision in both eyes. The symptoms are worse at night and the patient has stopped driving at night due to excessive glare from oncoming headlights. He has worked his entire life as a farmer and continues to drive tractors and other farm equipment during the day without difficulty. Medical history is unremarkable. Ocular examination shows loss of the red reflex and poor visualization of retinal detail. Acuity testing shows 20/100 vision in both eyes; visual field testing is normal. Which of the following is the most likely etiologic factor for this patient's eye condition?

- ☒ A. Accumulation of sorbitol in the lens (21%)
- ☐ B. Age-related oxidative injury (55%)
- ☐ C. Decreased collagen fibril production (3%)
- ☐ D. Ischemia and neovascularization (4%)
- ☐ E. Loss of lens distensibility (14%)

Incorrect

Block Time Remaining: 00:14:55

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Feedback



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End Block



Clinical features of age-related cataract

Risk factors

- Age >60
- Chronic sunlight exposure
- Diabetes mellitus
- Glucocorticoid use
- Smoking
- HIV infection

Symptoms

- Gradual loss of visual acuity
- Excessive glare, halos around bright lights
- Myopic shift

Signs

- Opacification of lens
- Loss of red reflex

This patient has **cataracts**: progressive **opacification** of the lenses with chronic **loss of visual acuity**.

Scattering of light within the lens leads to **glare and halos** around bright lights, especially at night.





This patient has **cataracts**: progressive **opacification** of the lenses with chronic **loss of visual acuity**. Scattering of light within the lens leads to **glare and halos** around bright lights, especially at night. Examination reveals cloudiness in the lens, decreased detail when examining the retina, and loss of the **red reflex**.

Transparency of the lens requires an ordered epithelial cell structure and maintenance of intracellular crystallins. **Aging** and environmental stressors can disrupt transparency and contribute to cataract formation through the following mechanisms:

- **Nuclear sclerosis**: new layers of epithelia form on the cortex of the lens, compacting older layers beneath
- **Photooxidative damage** and cross-linking of crystallins causes brown/yellow pigmentary changes
- **Osmotic injury** resulting in development of hydropic lens fibers that degenerate

Cumulative photooxidative stress is worsened by heavy **UV exposure** (eg, outdoor occupations), smoking, or ionizing radiation. Likewise, osmotic injury is accelerated in patients with diabetes mellitus. A disordered balance of prooxidative versus antioxidative compounds in the lens (eg, decreased glutathione) may also contribute.





Item 15 of 27

Question Id: 18951



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color

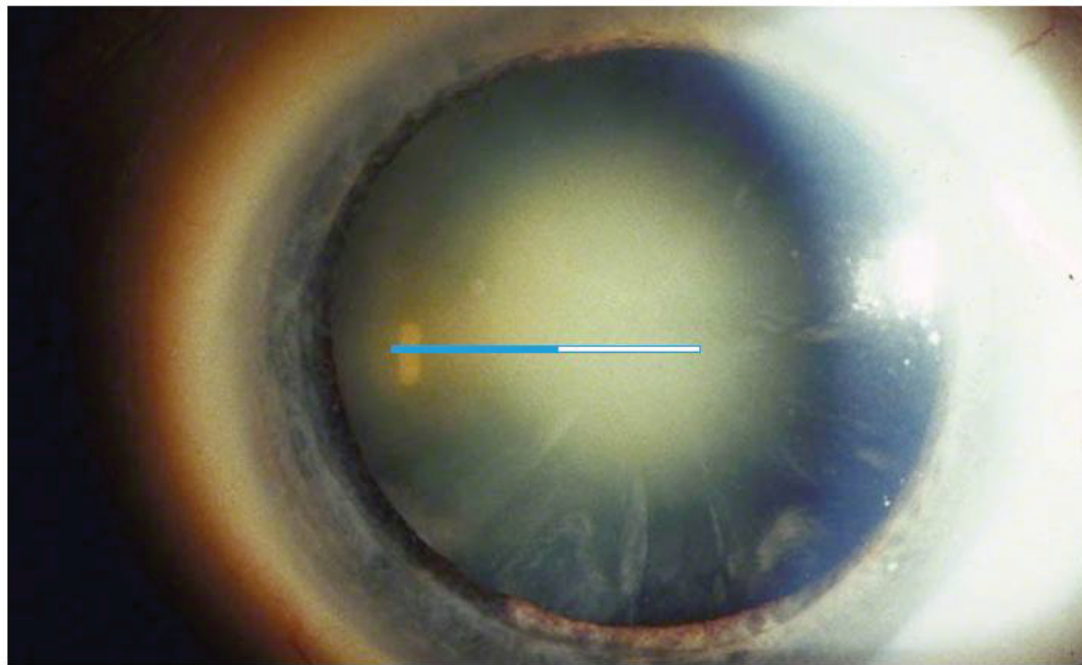


Text Zoom



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Block Time Remaining: 00:14:55

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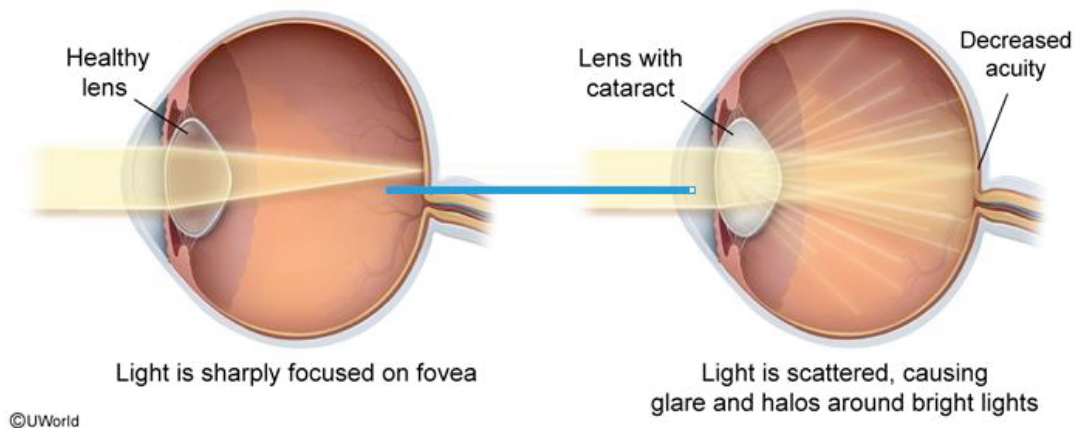


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Exhibit Display

Cataract



Zoom In



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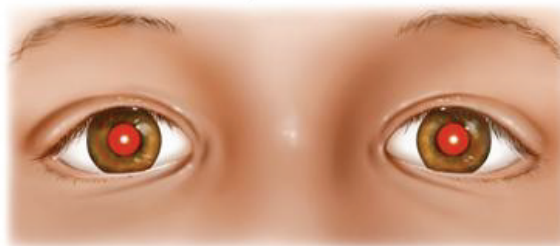
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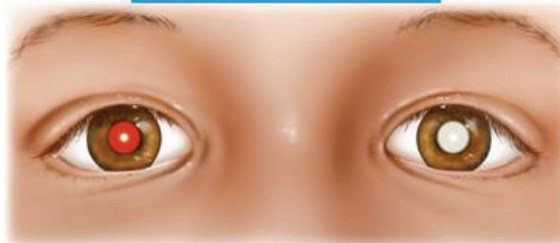
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Normal eyes & white reflex



Normal eyes

Red reflexes & corneal light reflexes are equal.



Absent reflex

White reflex on abnormal eye can result from opacities of the lens (eg, cataract) or tumor (eg, retinoblastoma).

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Zoom Out



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may also contribute.

(Choice A) In patients with diabetes, excess glucose is converted to sorbitol at a greater rate than sorbitol can be metabolized to fructose. Osmotic injury due to the higher concentration of sorbitol in the lens can lead to cataract. However, in patients without diabetes, the conversion of sorbitol to fructose is adequate to prevent the buildup of sorbitol.

(Choice C) Photoaging of skin is characterized by decreased collagen fibril production and loss of tissue elasticity in sun-exposed areas. However, defects in collagen production are not a significant contributor to cataract.

(Choice D) Microvascular ischemia in patients with long-standing diabetes can cause neovascularization in the retina, leading to diabetic retinopathy. Most patients are asymptomatic until late in the course of the disease, when vitreous hemorrhage or retinal detachment causes acute vision loss.

(Choice E) Presbyopia is a type of refractive error caused by loss of the normal distensibility of the lens with age. It reduces the ability of the eye to focus on near objects but does not cause loss of visual acuity.

Educational objective:

Cataracts are characterized by progressive opacification of the lens with chronic loss of visual acuity.

Aging and environmental exposures (eg, UV light) contribute to cataract formation by inducing nuclear

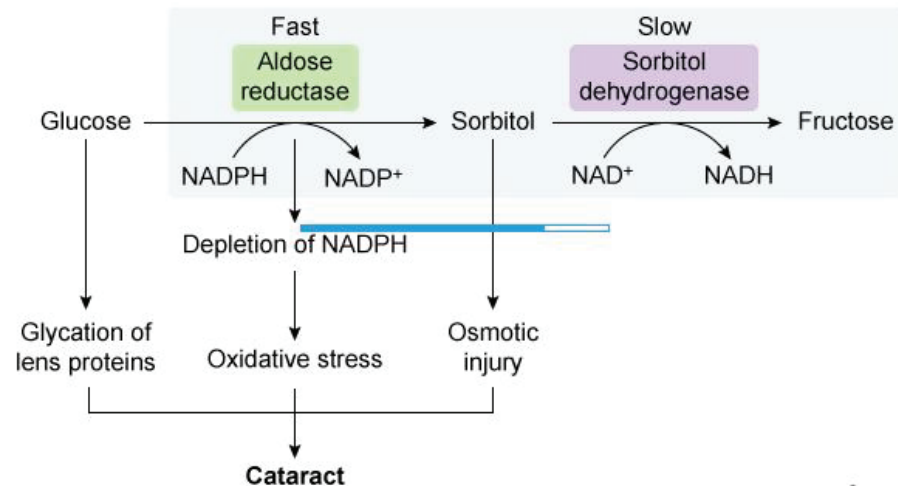




may also contribute.

Exhibit Display

Diabetic cataract formation



Zoom In



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prevent the buildup of sorbitol.

(Choice C) Photoaging of skin is characterized by decreased collagen fibril production and loss of tissue elasticity in sun-exposed areas. However, defects in collagen production are not a significant contributor to cataract.

(Choice D) Microvascular ischemia in patients with long-standing diabetes can cause neovascularization in the retina, leading to diabetic retinopathy. Most patients are asymptomatic until late in the course of the disease, when vitreous hemorrhage or retinal detachment causes acute vision loss.

(Choice E) Presbyopia is a type of refractive error caused by loss of the normal distensibility of the lens with age. It reduces the ability of the eye to focus on near objects but does not cause loss of visual acuity.

Educational objective:

Cataracts are characterized by progressive opacification of the lens with chronic loss of visual acuity. Aging and environmental exposures (eg, UV light) contribute to cataract formation by inducing nuclear sclerosis, photooxidative damage to lens crystallins, and osmotic injury.

References

- [Etiopathogenesis of cataract: an appraisal.](#)





A 28-year-old man comes to the emergency department after sustaining an accidental penetrating injury to the left eye. Examination shows left globe perforation with decreased visual acuity. The right eye is normal. The patient is otherwise healthy. Surgical treatment is performed with subsequent improvement in vision. Two months later, the patient experiences pain, photophobia, and diminished vision in the right eye. Evaluation shows leukocytes in the anterior chamber and vitreous humor and choroidal deposits consistent with granulomatous panuveitis. Disruption of which of the following immune processes is most likely responsible for this patient's current condition?

- ☐ A. Complement regulation
- ☐ B. Immune privilege
- ☐ C. Immune surveillance
- ☐ D. Immunoglobulin class switching
- ☐ E. Positive selection

Submit



A 28-year-old man comes to the emergency department after sustaining an accidental penetrating injury to the left eye. Examination shows left globe perforation with decreased visual acuity. The right eye is normal. The patient is otherwise healthy. Surgical treatment is performed with subsequent improvement in vision. Two months later, the patient experiences pain, photophobia, and diminished vision in the right eye. Evaluation shows leukocytes in the anterior chamber and vitreous humor and choroidal deposits consistent with granulomatous panuveitis. Disruption of which of the following immune processes is most likely responsible for this patient's current condition?

- ☐ A. Complement regulation (10%)
- ☒ B. Immune privilege (46%)
- ☐ C. Immune surveillance (26%)
- ☐ D. Immunoglobulin class switching (6%)
- ☒ E. Positive selection (10%)

Incorrect

Block Time Remaining: 00:16:20

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End Block



This patient with a **traumatic ocular injury** has developed granulomatous **inflammation of the contralateral eye**, a condition known as sympathetic ophthalmia. This occurs when there is a robust T-cell response to previously **sequestered antigens** in the eye, an area that displays **immune privilege**.

Certain anatomic sites (eg, **eyes, testes**) have inherent immune privilege, in which inflammation is inhibited by multiple mechanisms (eg, physical barriers, lack of lymphatics, low expression of MHC class Ia); this helps limit potential organ damage that may result from a robust inflammatory response.

Self-antigens located in immune-privileged sites can be recognized by T cells that escape negative selection in the thymus. Therefore, if these self-antigens are released into the lymphatic system as a result of trauma, T cells may **recognize these self-antigens as foreign** and mount a response in both the injured eye and the contralateral eye. Bacterial introduction and exposure during trauma may upregulate the inflammatory process, increasing the chances that these autoreactive T cells will develop.

Because of this potential sight-threatening immune response, if an eye is severely injured with no possibility that vision will be restored, it is **enucleated** (ie, surgically removed) **to prevent blindness** in the uninjured eye.

(Choice A) Disorders of complement regulation can lead to autoimmune disease (eg, **paroxysmal**



possibility that vision will be restored, it is enucleated (ie, surgically removed) to prevent blindness in the uninjured eye.

(Choice A) Disorders of complement regulation can lead to autoimmune disease (eg, *paroxysmal nocturnal hemoglobinuria*) or increased susceptibility to infections with encapsulated bacteria (eg, *Neisseria*), but these disorders are typically genetic conditions rather than the result of trauma.

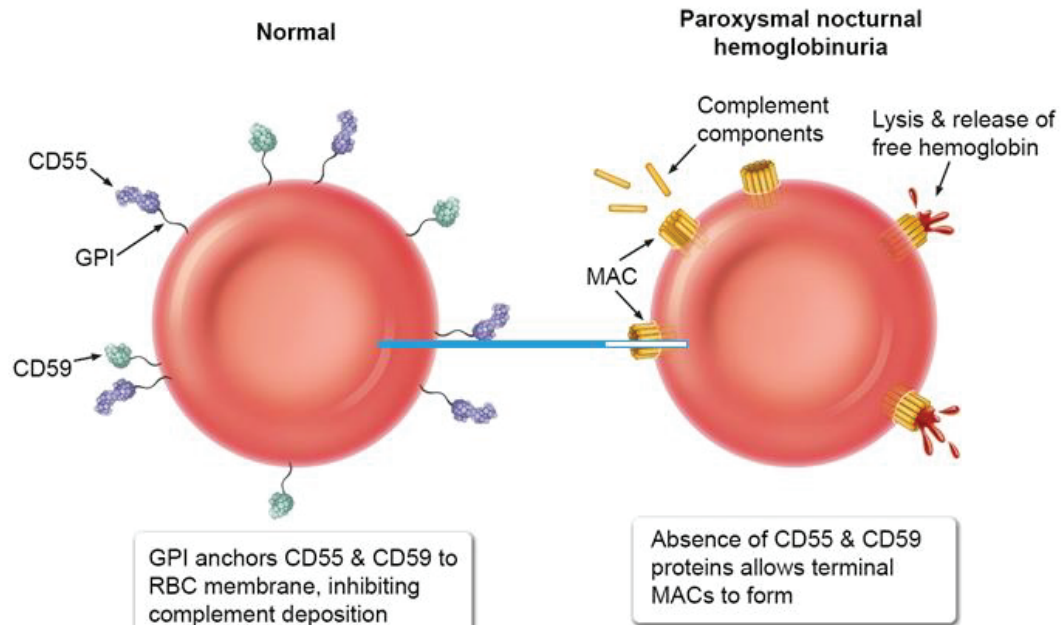
(Choice C) Immune surveillance is a process by which cytotoxic lymphocytes and natural killer cells can recognize neoplastic cells either by their expression of tumor antigens or by a lack of expression of self-antigens (eg, MHC class I).

(Choice D) Immunoglobulin class switching is the process through which activated B lymphocytes switch production from IgM immunoglobulins during the primary immune response to IgG and IgA isotypes, which are active during the secondary response. This occurs in the germinal centers of lymph nodes and requires interaction of the CD40 receptor on B cells with the CD40 ligand expressed by activated T cells.

(Choice E) Positive selection of T cells occurs prior to negative selection and is responsible for development of a T cell repertoire that can recognize and bind to self-MHC molecules. T cells expressing a T-cell receptor that is able to bind self-MHC are allowed to survive (although if that response is too strong, they will usually be eliminated through negative selection).



Exhibit Display



GPI = glycosylphosphatidylinositol; MAC = membrane attack complex; RBC = red blood cell.

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(Choice D) Immunoglobulin class switching is the process through which activated B lymphocytes switch production from IgM immunoglobulins during the primary immune response to IgG and IgA isotypes, which are active during the secondary response. This occurs in the germinal centers of lymph nodes and requires interaction of the CD40 receptor on B cells with the CD40 ligand expressed by activated T cells.

(Choice E) Positive selection of T cells occurs prior to negative selection and is responsible for development of a T cell repertoire that can recognize and bind to self-MHC molecules. T cells expressing a T-cell receptor that is able to bind self-MHC are allowed to survive (although if that response is too strong, they will usually be eliminated through negative selection).

Educational objective:

Traumatic injury to the eye, an area of the body that has inherent immune privilege, can lead to the release of previously sequestered antigens that T cells recognize as foreign. This can lead to subsequent inflammation and blindness in both the injured and uninjured eye.

Immunology

Ophthalmology

Immunology principles

Subject

System

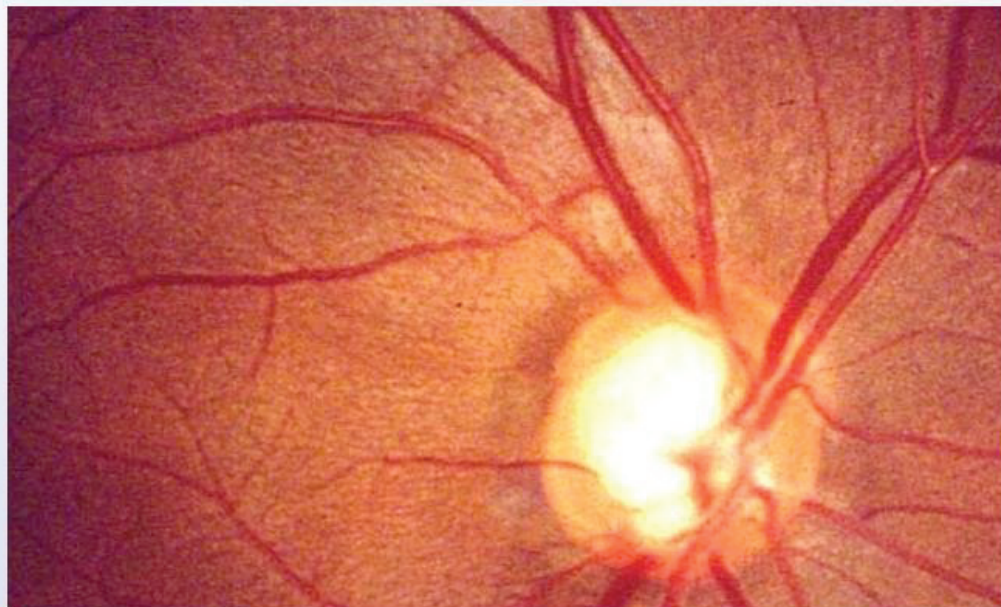
Topic

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A 58-year-old airline captain comes to the office after he was found to have abnormal vision testing during a pilot medical certification examination. The patient feels well and has no ocular symptoms. Vision testing shows normal visual acuity but moderate loss of peripheral vision in both eyes. Results of the fundusoscopic examination are shown in the image below.





Item 26 of 27

Question Id: 11841



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



Settings

Exhibit Display



Zoom In



Zoom Out



Reset



New



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Block Time Remaining: 00:16:24

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Feedback



Suspend



End Block



Other neurologic and cardiopulmonary examination findings are unremarkable. He is started on latanoprost eyedrops. The medication is most likely to improve this patient's condition through which of the following mechanisms?

- ☐ A. Decreased bicarbonate formation in ciliary body
- ☐ B. Decreased formation of abnormal blood vessels in retina
- ☐ C. Decreased secretion of aqueous humor
- ☐ D. Increased outflow of aqueous humor
- ☐ E. Vasoconstriction in ciliary body

Submit





Other neurologic and cardiopulmonary examination findings are unremarkable. He is started on **latanoprost** eyedrops. The medication is most likely to improve this patient's condition through which of the following mechanisms?

- ☐ A. Decreased bicarbonate formation in ciliary body (2%)
- ☐ B. Decreased formation of abnormal blood vessels in retina (10%)
- ☐ C. Decreased secretion of aqueous humor (21%)
- ☒ D. Increased outflow of aqueous humor (61%)
- ☐ E. Vasoconstriction in ciliary body (4%)

Correct

61%
Answered correctly

52 secs
Time Spent

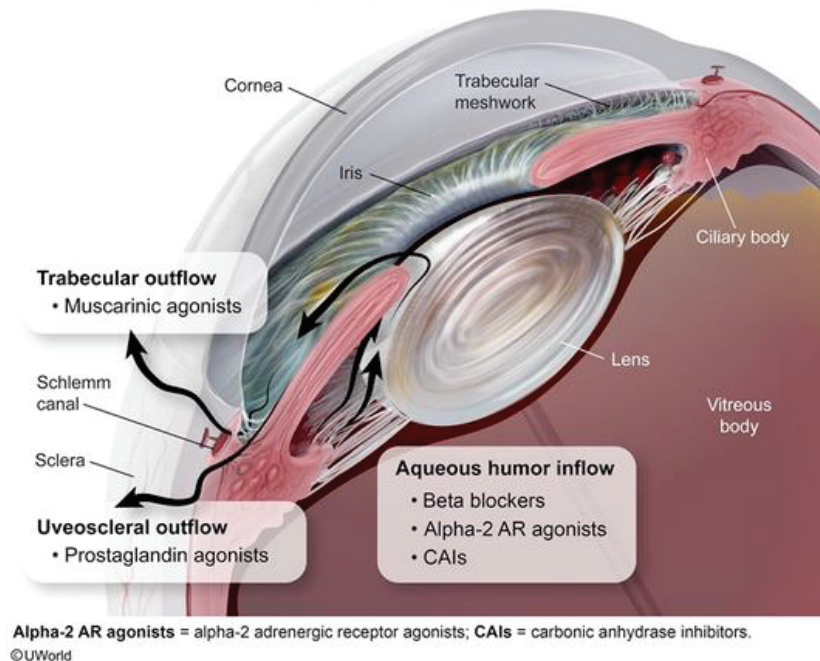
09/30/2020
Last Updated





Exhibit Display

Glaucoma medications



Zoom In



Zoom Out



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Aqueous humor is secreted by epithelial cells of the ciliary body into the posterior eye chamber. The fluid then flows through the pupil into the anterior chamber to the iridocorneal angle. Here, it diffuses through a trabecular network into Schlemm's canal (scleral venous sinus) and subsequently drains into episcleral and conjunctival veins. A small amount of aqueous can also diffuse through the ciliary muscle and adjacent sclera (uveoscleral pathway).

Open-angle glaucoma is characterized by **increased intraocular pressure** due to increased secretion or decreased outflow of aqueous humor. It is a form of optic neuropathy and causes progressive loss of ganglion cell axons, which may be **visualized** as a pale optic disc and enlarged optic cup (compared to **normal retina**). Symptoms evolve over decades, with progressive loss of **peripheral visual fields**.

Glaucoma is managed with agents that either decrease production or increase outflow of aqueous humor. Latanoprost is a topical **prostaglandin** used in the treatment of glaucoma. It is applied as a prodrug and converted to the active form by esterases in the cornea. Prostaglandins are the preferred first-line agents for the treatment of glaucoma, and although the exact mechanism of action is uncertain, they have been found to decrease the collagen content in the uveoscleral outflow pathway and **increase outflow** of aqueous humor. They are also known to cause increased pigmentation in the iris and eyelashes.

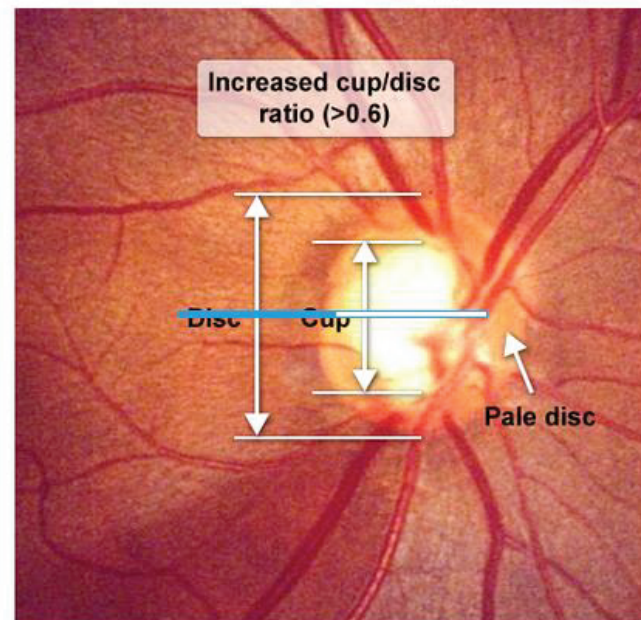
(Choices A, C, and E) Carbonic anhydrase inhibitors (e.g., dorzolamide) decrease formation of bicarbonate





Exhibit Display

Glaucomatous optic atrophy (moderate)





Item 26 of 27

Question Id: 11841



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



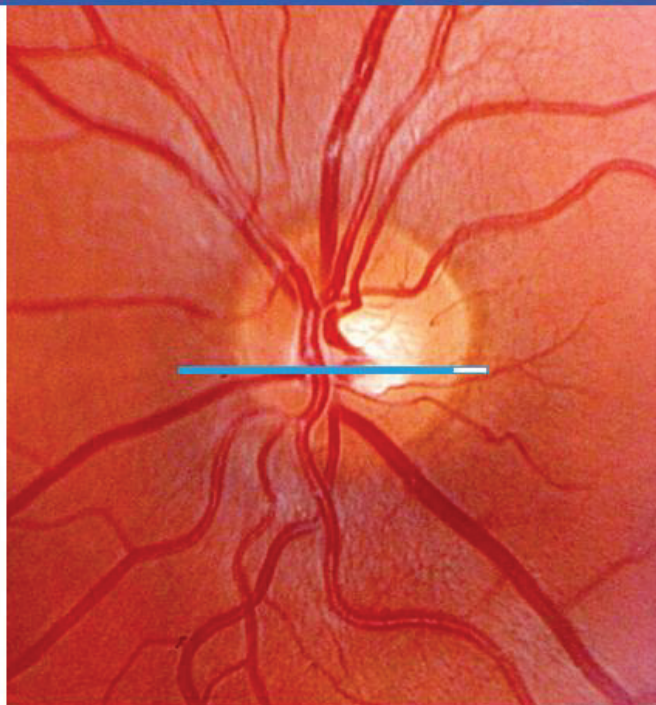
Text Zoom



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Exhibit Display



Zoom In



Zoom Out



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Block Time Remaining: 00:17:12

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Feedback



Suspend



End Block



found to decrease the collagen content in the uveoscleral outflow pathway and **increase outflow** of aqueous humor. They are also known to cause increased pigmentation in the iris and eyelashes.

(Choices A, C, and E) Carbonic anhydrase inhibitors (eg, dorzolamide) decrease formation of bicarbonate in the ciliary body, leading to decreased sodium and fluid transport and subsequently decreased production of aqueous humor. Alpha-adrenergic agonists (eg, brimonidine) inhibit production of aqueous humor due to vasoconstriction in the ciliary body. Beta blockers (eg, timolol) also decrease production of aqueous humor. Prostaglandins do not affect production of aqueous humor but are often used in combination with these other agents.

(Choice B) Increased formation of new blood vessels at the optic disc is the characteristic feature of proliferative diabetic retinopathy. Strict control of diabetes will reduce the risk of diabetic retinopathy, but it is not affected by topical prostaglandins.

Educational objective:

Glaucoma is a form of optic neuropathy characterized by increased intraocular pressure associated with increased production or decreased outflow of aqueous humor. Topical prostaglandins (eg, latanoprost) increase outflow of aqueous via the uveoscleral pathway and are the preferred treatment for open-angle glaucoma.



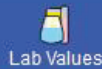


A 34-year-old woman comes to the physician complaining of double vision. She first experienced difficulty focusing her eyes while at work yesterday. Upon waking up this morning, her symptoms had progressed to frank diplopia. Her past medical history is insignificant. A complete physical examination is performed, including a full neurologic assessment. Shining light into her right eye causes constriction of her right pupil, but not the left pupil. Shining light into her left eye causes constriction of only her right pupil. Which of the following additional physical examination findings is likely to be found in this patient?

- ☐ A. Absence of the left corneal reflex
- ☒ B. Drooping of the left eyelid
- ☐ C. Inability to close the left eye
- ☐ D. Inward deviation of the left eye
- ☐ E. Visual loss in the left eye

Submit





A 34-year-old woman comes to the physician complaining of **double vision**. She first experienced difficulty focusing her eyes while at work yesterday. Upon waking up this morning, her symptoms had progressed to frank **diplopia**. Her past medical history is insignificant. A complete physical examination is performed, including a full neurologic assessment. Shining light into her right eye causes constriction of her right pupil, but **not the left pupil**. Shining light into her left eye causes constriction of only her right pupil. Which of the following additional physical examination findings is likely to be found in this patient?

- ☐ A. Absence of the left corneal reflex (17%)
- ☒ B. Drooping of the left eyelid (60%)
- ☐ C. Inability to close the left eye (3%)
- ☐ D. Inward deviation of the left eye (10%)
- ☐ E. Visual loss in the left eye (8%)

Correct

60%
Answered correctly

02 mins, 14 secs
Time Spent

12/12/2020
Last Updated

Block Time Remaining: 00:19:26
TUTOR

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Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



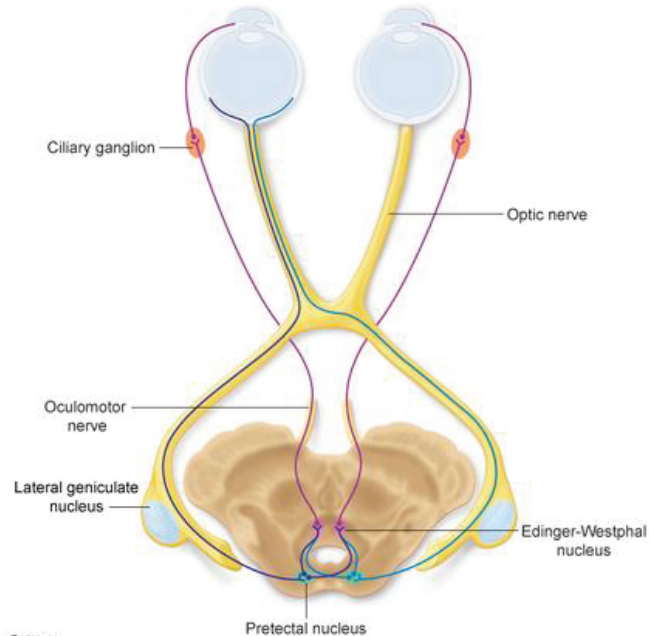
Text Zoom



Settings

Exhibit Display

Pupillary light reflex



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Zoom In



Zoom Out



Reset



New | Existing



My Notebook



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Feedback



Suspend



End Block



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Pretectal nucleus

The pupillary light reflex is assessed by shining light in an eye and observing the response in that eye (direct) as well as the opposite eye (consensual). The optic nerve (CN II) is responsible for the afferent limb of this reflex; the oculomotor nerve (CN III) is responsible for the efferent limb. In this patient, the right CN II and right CN III are functional as there was a direct response seen when light was shined into the right eye. In addition, the left CN II is also functional as a consensual response occurred when light was shined into the left eye. However, constriction of the left pupil was not seen in either circumstance. Thus, this patient's lesion most likely involves her left CN III.

The symptoms of CN III palsy relate to the function of CN III:

1. A somatic component innervates the inferior, superior, and medial rectus; inferior oblique; and levator palpebrae muscles. Ptosis occurs due to paralysis of the levator palpebrae, and the unopposed action of the lateral rectus (CN VI) and superior oblique (CN IV) muscles leads to a "down-and-out" gaze.
2. Parasympathetic fibers of CN III innervate the iris sphincter and ciliary muscle. Paralysis of these fibers causes a fixed, dilated pupil and loss of accommodation.

CN III palsy can result from lesions anywhere along the nerve's path from the oculomotor nucleus in the midbrain to the extraocular muscles within the orbit. The most dreaded cause of isolated acute third nerve



CN III palsy can result from lesions anywhere along the nerve's path from the oculomotor nucleus in the midbrain to the extraocular muscles within the orbit. The most dreaded cause of isolated acute third nerve palsy is an actively enlarging intracranial aneurysm (at risk of imminent rupture).

(Choice A) Absence of the corneal reflex can result from lesions involving CN V₁ (afferent limb) or CN VII (efferent limb).

(Choice C) A lesion involving the left CN VII would result in inability to close the left eye.

(Choice D) Inward deviation of the left eye would result from a CN VI lesion and the resultant unopposed action of CN III.

(Choice E) The left CN II is functional as it was able to produce a consensual response in the right eye.

Educational objective:

The pupillary light reflex is assessed by shining light in an eye and observing the response in that eye (direct) and the opposite eye (consensual). The optic nerve (CN II) is responsible for the afferent limb of the pupillary reflex, and the oculomotor nerve (CN III) is responsible for the efferent limb.

Anatomy Ophthalmology Cranial nerve palsy

Block Time Remaining: 00:19:26

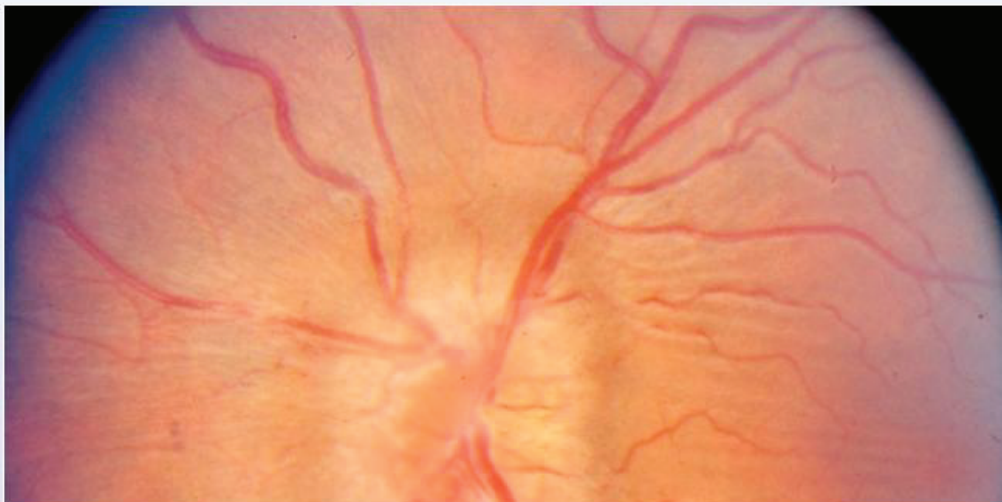
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A 31-year-old woman comes to the office due to transient visual changes that are characterized by "loss of vision for a minute" and commonly precipitated by bending forward or lifting objects. During the last 3 months, she has had persistent headaches that she attributes to migraines. The patient takes over-the-counter analgesics as needed. Blood pressure is 140/90 mm Hg and pulse is 72/min and regular. BMI is 32.4 kg/m². Fundusoscopic findings of the left eye are shown in the image below, with similar findings in the right eye.





Item 24 of 27
Question Id: 12257



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color

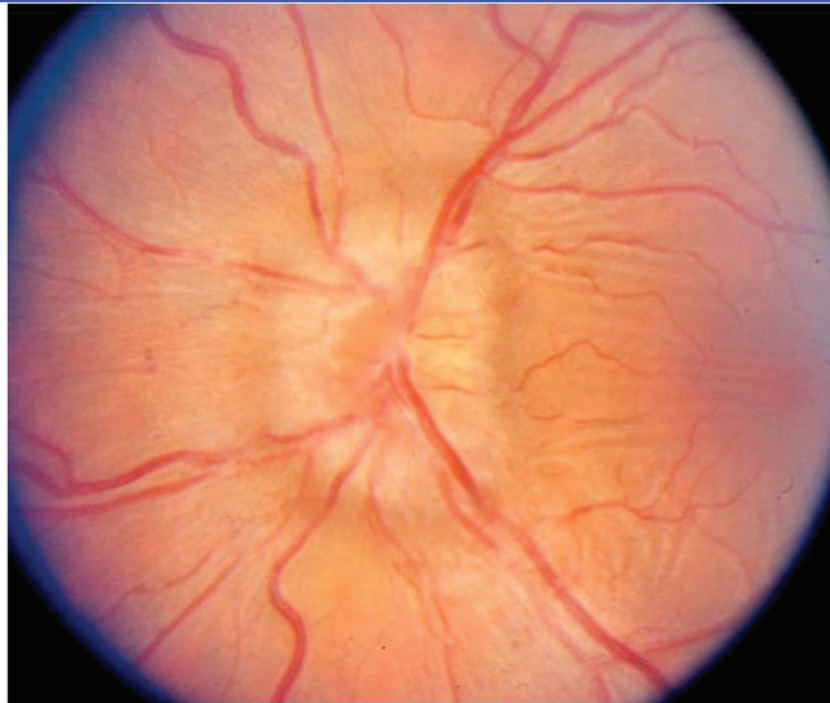


Text Zoom



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Exhibit Display



Zoom In



Zoom Out



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New



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Block Time Remaining: 00:19:30
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Feedback



Suspend



End Block



Which of the following is the most likely cause of the observed funduscopy findings in this patient?

- ☐ A. Choroidal inflammation
- ☐ B. Elevated intracranial pressure
- ☐ C. Elevated intraocular pressure
- ☐ D. Optic nerve inflammation
- ☐ E. Retinal ischemia

Submit





Which of the following is the most likely cause of the observed funduscopy findings in this patient?

- ☐ A. Choroidal inflammation (0%)
- ☒ B. Elevated intracranial pressure (70%)
- ☐ C. Elevated intraocular pressure (17%)
- ☐ D. Optic nerve inflammation (3%)
- ☐ E. Retinal ischemia (8%)

Correct



70%



47 secs



12/29/2020

Block Time Remaining: 00:20:13

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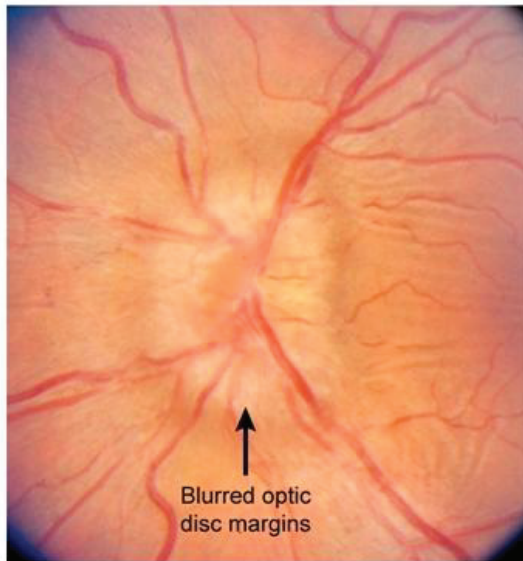


Normal optic disc



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Papilledema



This patient's clinical presentation is consistent with **idiopathic intracranial hypertension** (pseudotumor cerebri). This condition typically presents in young obese women with **daily headache**, bilaterally symmetric papilledema, and **transient visual disturbances** related to impaired cerebral venous outflow



This patient's clinical presentation is consistent with **idiopathic intracranial hypertension** (pseudotumor cerebri). This condition typically presents in young obese women with **daily headache**, bilaterally symmetric papilledema, and **transient visual disturbances** related to impaired cerebral venous outflow and **elevated intracranial pressure**. Symptoms characteristically worsen during the Valsalva maneuver (eg, bending down, coughing) because intracranial pressure increases.

Increased intracranial pressure is transmitted through the cerebrospinal fluid in the subarachnoid space, which is continuous with the optic nerve sheath. This buildup of pressure compresses the optic nerves externally, which in turn **impairs axoplasmic flow** within the **optic nerves**, causing bilateral optic disc edema (**papilledema**). Funduscopy shows elevation of the optic disc with blurred disc margins.

(Choice A) Choroidal inflammation is characteristic of posterior uveitis, which typically presents with painless vision loss and floaters. Ophthalmic examination may show inflammation/leukocytes in the vitreous humor. Uveitis is often associated with systemic inflammatory disorders (eg, inflammatory bowel disease, ankylosing spondylitis).

(Choice C) An acute increase in intraocular pressure is characteristic of angle-closure glaucoma, which typically presents with painful monocular vision loss, headache, vomiting, and conjunctival injection with a poorly reactive middilated pupil. Chronic increases in intraocular pressure can cause **optic disc cupping**

(Choice C) An acute increase in intraocular pressure is characteristic of angle-closure glaucoma, which typically presents with painful monocular vision loss, headache, vomiting, and conjunctival injection with a poorly reactive mid-dilated pupil. Chronic increases in intraocular pressure can cause optic disc cupping due to atrophy of the optic nerve head. Glaucoma usually affects older individuals.

(Choice D) Optic neuritis is frequently associated with multiple sclerosis, a demyelinating CNS disease that typically affects women age 15-50. Although swelling of the optic disc can be present on funduscopy, optic neuritis usually causes sustained monocular vision loss over several weeks with painful eye movement rather than daily headaches with transient bilateral vision loss.

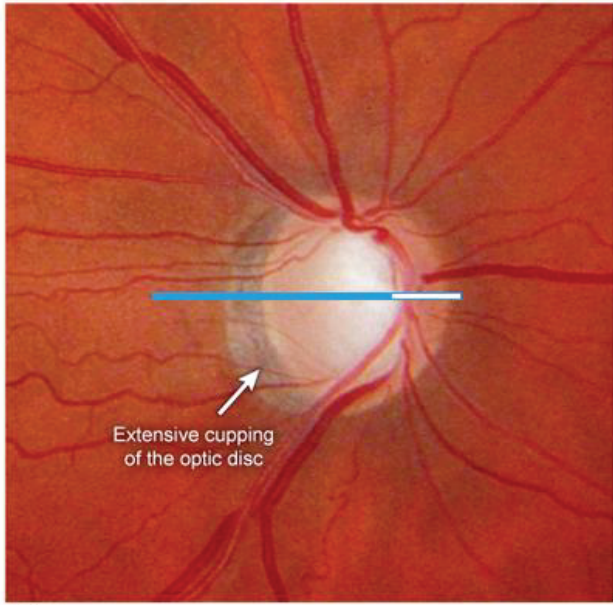
(Choice E) Retinal ischemia can manifest with painless transient monocular vision loss (amaurosis fugax) and is most commonly caused by atherosclerotic emboli originating from the ipsilateral carotid artery. Funduscopy may show embolic plaques and retinal whitening caused by ischemia. This condition typically affects older patients with vascular risk factors (eg, hypertension, hyperlipidemia, diabetes mellitus).

Educational objective:

Idiopathic intracranial hypertension (pseudotumor cerebri) presents in young obese women with daily headache (which worsens during the Valsalva maneuver), bilaterally symmetric papilledema, and transient visual disturbances. Increased intracranial pressure compresses the optic nerves, resulting in impaired axoplasmic flow and optic disc edema.

Exhibit Display

Glaucomatous optic atrophy (advanced)



Extensive cupping of the optic disc

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Zoom In Zoom Out Reset New Existing My Notebook



A 58-year-old man comes to the emergency department due to vision disturbances. Over the past several weeks, the patient has had intermittent episodes in which he sees everything tinted with blue. His vision returned to normal within a few hours each time. When he woke up today, vision in the left eye was blurry. He has had no eye pain, conjunctival redness, or headache. The patient has tingling and numbness in the feet due to diabetic neuropathy, which is unchanged, and reports no other focal weakness or sensory loss. Medical history is notable for hypertension, type 2 diabetes mellitus, hyperlipidemia, and erectile dysfunction. Vital signs are within normal limits. Physical examination shows an afferent pupillary defect, decreased visual acuity, and optic disc edema in the left eye. Discontinuing which of the following medications may improve this patient's vision?

- ☐ A. Amitriptyline
- ☐ B. Atorvastatin
- ☐ C. Canagliflozin
- ☐ D. Metformin
- ☐ E. Ramipril





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- ☐ D. Metformin
- ☐ E. Ramipril
- ☐ F. Sildenafil





He has had no eye pain, conjunctival redness, or headache. The patient has tingling and numbness in the feet due to diabetic neuropathy, which is unchanged, and reports no other focal weakness or sensory loss. Medical history is notable for hypertension, type 2 diabetes mellitus, hyperlipidemia, and erectile dysfunction. Vital signs are within normal limits. Physical examination shows an afferent pupillary defect, decreased visual acuity, and optic disc edema in the left eye. Discontinuing which of the following medications may improve this patient's vision?

- ☐ A. Amitriptyline (23%)
- ☐ B. Atorvastatin (1%)
- ☐ C. Canagliflozin (7%)
- ☐ D. Metformin (2%)
- ☐ E. Ramipril (3%)
- ☒ F. Sildenafil (62%)

Correct

62%



53 secs



02/15/2021

Block Time Remaining: 00:21:06

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Feedback



Suspend



End Block



Adverse effects of phosphodiesterase 5 inhibitors

Cardiovascular	<ul style="list-style-type: none">• Hypotension (especially with nitrates, alpha blockers)
Ocular	<ul style="list-style-type: none">• Blue discoloration of vision• Nonarteritic anterior ischemic optic neuropathy
Genitourinary	<ul style="list-style-type: none">• Priapism
Other	<ul style="list-style-type: none">• Flushing• Headache• Hearing loss

Normal male erectile function involves interplay between psychological and physical stimulation and the vascular, neurologic, and hormonal systems. On a vascular level, penile erection is induced by increased blood flow to the corpora cavernosa and corpus spongiosum accompanied by decreased outflow.

Endothelial factors required for erection include formation of nitric oxide, which induces formation of cyclic GMP (cGMP), which in turn mediates vascular smooth muscle relaxation. cGMP is inactivated by cGMP phosphodiesterase (PDE) (ie, PDE5), which cleaves cGMP and terminates penile erection.





PDE5 inhibitors (eg, sildenafil, tadalafil) are widely used, first-line agents for treatment of **erectile dysfunction** (ED). PDE5 inhibitors increase activity of cGMP in the penile corpora, leading to greater and more prolonged tumescence in men with ED.

However, PDE5 inhibitors can also inhibit PDE6 in the retina, which is involved in color vision. Patients experience this effect as a transient **bluish discoloration** to vision. Less common ocular effects of PDE5 inhibitors include **nonarteritic anterior ischemic optic neuropathy**, which presents with sudden monocular vision loss associated with an afferent pupillary defect, decreased visual acuity, and optic disc edema.

(Choice A) The anticholinergic effects of tricyclic antidepressants (eg, amitriptyline) can cause dry eye, blurred vision, and triggering of angle-closure glaucoma (ie, ocular pain, headache, unilateral vision loss). Discoloration of vision is not typical.

(Choice B) Important side effects of statins (eg, atorvastatin) include myopathy and hepatic toxicity. Statins may have a small effect on the risk of cataract but otherwise have few ocular manifestations.

(Choice C) Sodium-glucose cotransporter 2 inhibitors (eg, canagliflozin) induce increased renal excretion of glucose and water. Most of the side effects (eg, hypotension, urinary tract infection) are related to





(Choice B) Important side effects of statins (eg, atorvastatin) include myopathy and hepatic toxicity.

Statins may have a small effect on the risk of cataract but otherwise have few ocular manifestations.

(Choice C) Sodium-glucose cotransporter 2 inhibitors (eg, canagliflozin) induce increased renal excretion of glucose and water. Most of the side effects (eg, hypotension, urinary tract infection) are related to glucosuria and fluid shifts; visual symptoms are not common.

(Choice D) Metformin most commonly causes gastrointestinal side effects (eg, nausea, diarrhea). Lactic acidosis is a potentially serious but rare complication. Visual side effects are not a significant concern.

(Choice E) Side effects of ACE inhibitors (eg, ramipril) are primarily related to renal function (eg, hyperkalemia, acute kidney injury) or blood pressure (eg, dizziness, hypotension). Patients may also develop a dry cough due to an increase in circulating bradykinin.

Educational objective:

Phosphodiesterase 5 inhibitors (eg, sildenafil, tadalafil) can cause a transient bluish discoloration to vision. Less common ocular effects include sudden monocular vision loss due to nonarteritic anterior ischemic optic neuropathy; findings include an afferent pupillary defect, decreased visual acuity, and optic disc edema.

References





A 57-year-old man is brought to the emergency department following a generalized tonic-clonic seizure. His wife reports that he has no history of seizures. However, she says that he has been complaining of intermittent headaches, memory loss, and problems with his vision for the past 2 weeks. Brain imaging shows a solitary mass within the right temporal lobe. Which of the following visual field defects is most likely present in this patient?

	Left	Right
<input type="radio"/> A.		
<input type="radio"/> B.		
<input type="radio"/> C.		





Item 22 of 27

Question Id: 8594



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom

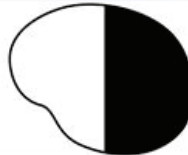


Settings

☐ A.



☐ B.



☐ C.



☐ D.



☐ E.



Block Time Remaining: 00:21:13

TUTOR

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Feedback



Suspend



End Block



Item 22 of 27

Question Id: 8594



Mark

Previous

Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



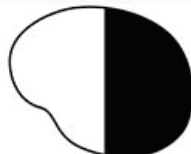
Text Zoom



Settings



B.



(4%)



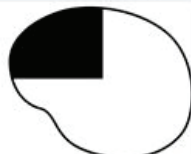
C.



(20%)



D.



(64%)



E.



(7%)

Correct



64%

Answered correctly



38 secs

Time spent



02/24/2021

Last Updated

Block Time Remaining: 00:21:44

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Feedback



Suspend

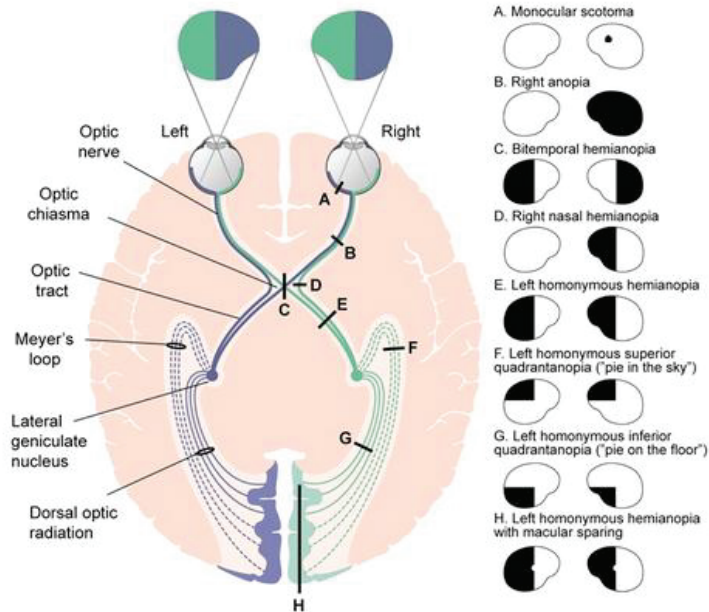


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Exhibit Display

Visual pathways from above



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Reset



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Damage to the visual pathway produces distinct types of visual field defects depending on the location of the lesion. Visual perception begins with light from the nasal visual fields striking the temporal side of each retina and light from the temporal visual fields striking the nasal side of each retina. Information from the retina is then transmitted by the optic nerves to the optic chiasm. At the optic chiasm, optic nerve fibers from the nasal half of each retina cross and project into the contralateral optic tract. In contrast, nerve fibers from the temporal parts pass into the ipsilateral optic tract. The optic tract thus contains nerve fibers from the temporal part of the ipsilateral retina and the nasal part of the contralateral retina. Optic tract fibers project mainly to the lateral geniculate nucleus (LGN), but also project to superior colliculus (reflex gaze), pretectal area (light reflex), and the suprachiasmatic nucleus (circadian rhythms).

Axons from the LGN that project to the striate (primary visual) cortex are known as the optic radiation (or geniculocalcarine tract). The lower fibers of the optic radiation carry information from the lower retina (upper contralateral visual field) and take a circuitous route anteriorly into the temporal lobe (Meyer's loop) before reaching the lingual gyrus of the striate cortex. The upper fibers of the optic radiation carry information from the upper retina (lower contralateral visual field) and pass more directly from the LGN through the parietal lobe to reach the cuneus gyrus of the striate cortex.

Lesions in the temporal lobe can disrupt Meyer's loop and produce a contralateral superior quadrantanopia. Temporal lobe lesions can also produce other neurologic manifestations, including



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Lesions in the temporal lobe can disrupt Meyer's loop and produce a contralateral superior quadrantanopia. Temporal lobe lesions can also produce other neurologic manifestations, including aphasia (dominant hemisphere lesions), memory deficits, seizures (complex partial and tonic-clonic), and hallucinations (auditory, olfactory, and visual).

Educational objective:

Injury to Meyer's loop in the temporal lobe results in contralateral superior quadrantanopia.

Anatomy

Ophthalmology

Visual pathway

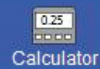
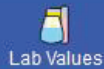
Subject

System

Topic

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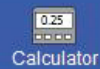
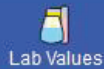


A 67-year-old smoker comes to the office with a 2-week history of decreased vision in his right eye that he describes as "blurry" and "distorted." The patient has been having vision problems over the past year, and these have made it more difficult to drive and require that he use a bright light to read the newspaper. He has no history of diabetes mellitus or hypertension. The patient uses an albuterol inhaler for occasional wheezing and shortness of breath. Ophthalmologic examination of the right eye shows a grayish discoloration of the macula with areas of adjacent hemorrhage. Which of the following should be specifically targeted in treatment of this patient's condition?

- ☐ A. CD20 lymphocyte glycoprotein
- ☐ B. Epidermal growth factor receptor
- ☐ C. Interleukin-2
- ☐ D. Tumor necrosis factor-alpha
- ☐ E. Vascular endothelial growth factor

Submit





A 67-year-old smoker comes to the office with a 2-week history of decreased vision in his right eye that he describes as "blurry" and "distorted." The patient has been having vision problems over the past year, and these have made it more difficult to drive and require that he use a bright light to read the newspaper. He has no history of diabetes mellitus or hypertension. The patient uses an albuterol inhaler for occasional wheezing and shortness of breath. Ophthalmologic examination of the right eye shows a grayish discoloration of the macula with areas of adjacent hemorrhage. Which of the following should be specifically targeted in treatment of this patient's condition?

- ☐ A. CD20 lymphocyte glycoprotein (1%)
- ☐ B. Epidermal growth factor receptor (6%)
- ☐ C. Interleukin-2 (3%)
- ☐ D. Tumor necrosis factor-alpha (6%)
- ☒ E. Vascular endothelial growth factor (82%)





This patient likely has **age-related macular degeneration (AMD)**, the leading cause of blindness in industrialized countries. AMD occurs in genetically predisposed individuals as a result of advancing age and environmental factors (eg, smoking) and is classified into dry and wet subtypes. **Dry AMD** is characterized by **gradual** vision loss in one or both eyes and can cause difficulty with driving/reading. The condition likely results from chronic oxidative damage to the retinal pigment epithelium and choriocapillaris, leading to subretinal inflammation with abnormal extracellular matrix formation (eg, confluent drusen, basement membrane thickening). These changes appear on funduscopy as subretinal **drusen deposits** with pigment abnormalities.

Progressive extracellular matrix accumulation can eventually result in retinal hypoxia, which stimulates local vascular endothelial growth factor (VEGF) production and causes subretinal neovascularization with formation of leaky vessels. This condition is termed **wet AMD** and presents with **acute** vision loss (days to weeks) with **metamorphopsia** (distortion of straight lines). **Funduscopy** shows a grayish-green subretinal discoloration with adjacent fluid/hemorrhage.

Patients with dry or wet AMD may benefit from antioxidant vitamins and zinc, and smokers should receive **smoking cessation** counseling to prevent disease progression. Wet AMD usually requires specific treatment with **VEGF inhibitors** (eg, ranibizumab, bevacizumab).





Item 21 of 27

Question Id: 7721



Mark



Previous



Next



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Tutorial



Lab Values



Notes



Calculator



Reverse Color

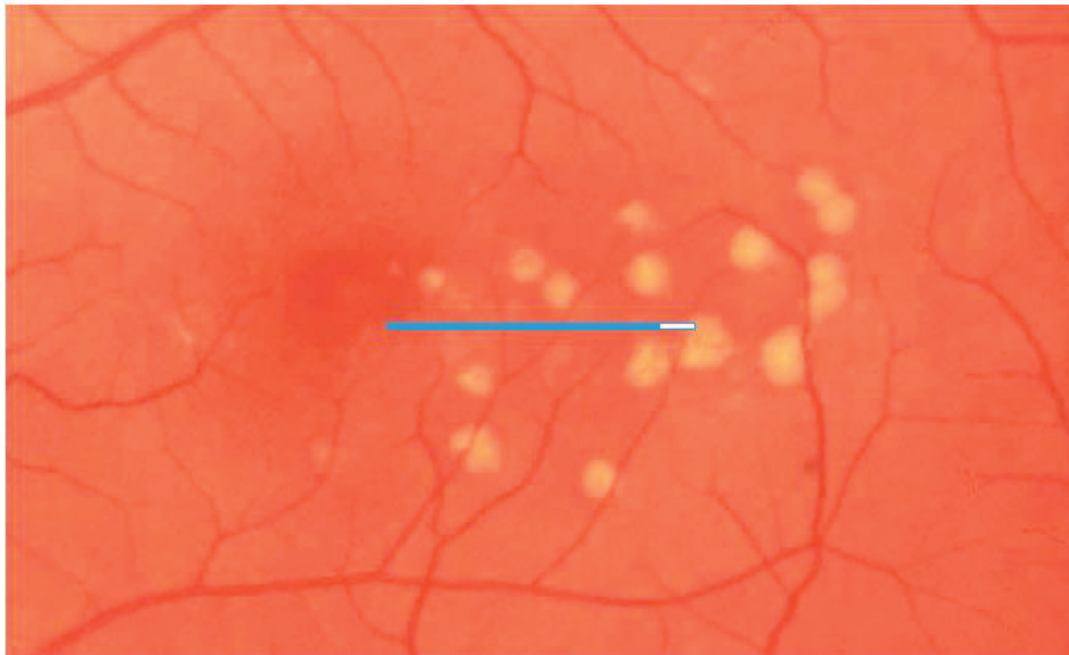


Text Zoom



Settings

Exhibit Display

AMD, Calcified Drusen (#1) AMD, Exudative

Zoom In



Zoom Out



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treatment with **VEGF inhibitors** (eg ranibizumab, bevacizumab)

Block Time Remaining: 00:23:26

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Feedback



Suspend



End Block



Item 21 of 27

Question Id: 7721



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



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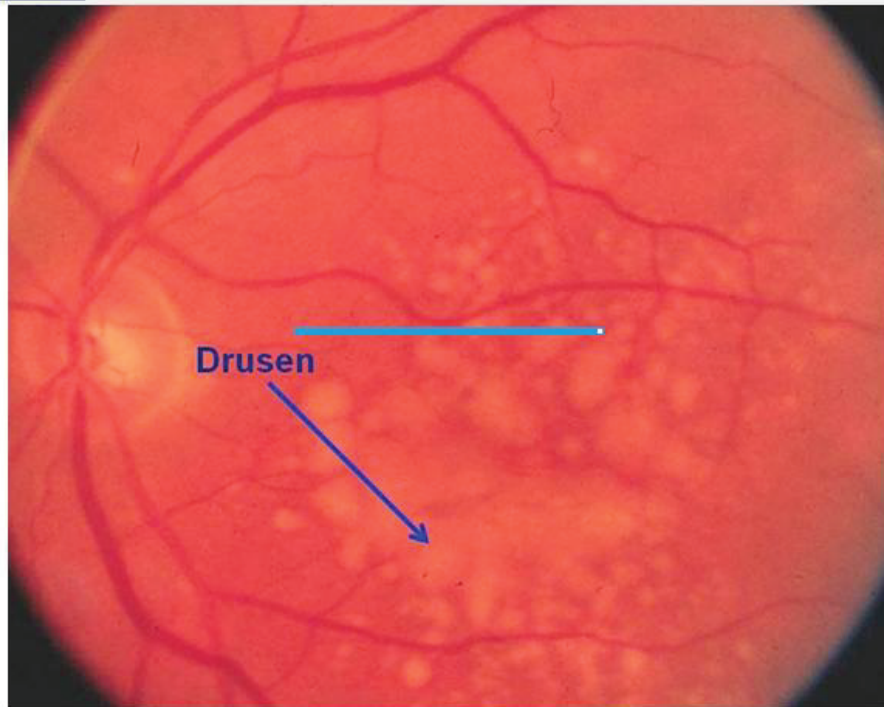


Text Zoom



Settings

Exhibit Display

AMD, Calcified Drusen (#1) AMD, Exudative

Zoom In



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Item 21 of 27

Question Id: 7721



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



Settings

Exhibit Display



Zoom In



Zoom Out



Reset



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My Notebook

treatment with **VEGF inhibitors** (eg ranibizumab, bevacizumab)

Block Time Remaining: 00:23:26

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Feedback



Suspend



End Block



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



Settings

treatment with **VEGF inhibitors** (eg, ranibizumab, bevacizumab).

(Choice A) Therapy against the CD20 glycoprotein on B cells (eg, the monoclonal antibody rituximab) is used to treat various lymphomas and active rheumatoid arthritis.

(Choice B) Epidermal growth factor receptor inhibitors (eg, erlotinib, gefitinib) are used to treat advanced non-small cell lung cancer.

(Choice C) Anti-interleukin-2 therapy is primarily used for immunosuppression in organ transplant patients and in conditions such as graft versus host disease.

(Choice D) Inhibitors of tumor necrosis factor-alpha are used in many inflammatory autoimmune conditions, such as rheumatoid arthritis, inflammatory bowel disease, and seronegative spondyloarthropathies.

Educational objective:

Wet age-related macular degeneration is characterized by retinal neovascularization due to increased vascular endothelial growth factor (VEGF) levels. Patients typically have acute vision loss and metamorphopsia with funduscopy showing a grayish-green subretinal membrane and/or subretinal hemorrhage. Treatment includes smoking cessation and VEGF inhibitor therapy (eg, ranibizumab, bevacizumab).



0



Feedback



Suspend



End Block



A 63-year-old man comes to the office due to blurred vision in both eyes for the last 2 days. The blurriness is worse when he reads but is not noticeable when he drives. The patient has no associated headache, double vision, or weakness. However, he did start taking diphenhydramine several days ago for seasonal allergies. Past medical history is unremarkable. Vital signs are normal. On physical examination, there is edema and clear drainage affecting the nasal mucosa. Funduscopic examination is normal. This patient's visual symptoms are most likely due to blockade of which of the following mediators?

- ☐ A. Acetylcholine
- ☐ B. Histamine
- ☐ C. Leukotrienes
- ☐ D. Norepinephrine
- ☐ E. Serotonin

Submit



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- ✓ ☒ A. Acetylcholine (65%)
- ☐ B. Histamine (27%)
- ☐ C. Leukotrienes (1%)
- ☐ D. Norepinephrine (4%)
- ☐ E. Serotonin (0%)

Correct



65%

Answered correctly



01 min, 05 secs

Time Spent



02/08/2021

Last Updated

Block Time Remaining: 00:24:31

TUTOR

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Feedback



Suspend



End Block



This patient has impaired visual accommodation due to **anticholinergic** (anti-muscarinic) effects of **first-generation antihistamines** (eg, chlorpheniramine, diphenhydramine). Antihistamines are designed to relieve the allergic symptoms caused by release of histamine from mast cells (eg, rhinorrhea, itchy eyes and nose, urticaria). However, first-generation antihistamines can have prominent side effects due to blockade of other receptors, including alpha-adrenergic, serotonergic, and cholinergic receptors.

The **ciliary muscle** attaches to the lens via the zonular fibers. Contraction of the muscle reduces tension on the fibers, allowing the lens to become more spherical and increasing its refractive power. The ciliary muscle is under parasympathetic control from the **Edinger-Westphal nucleus/ciliary ganglion**. Inhibition of this pathway by antimuscarinic agents will limit **accommodation** and cause blurring of vision for close objects. The pupillary sphincter also receives parasympathetic innervation from the Edinger-Westphal nucleus, and patients on antimuscarinic agents may have mydriasis (pupillary dilation) as well.

(Choice B) First-generation antihistamines easily cross the blood-brain barrier into the central nervous system, where they interfere with the normal neurotransmitter functions of histamine. Side effects can include drowsiness and cognitive dysfunction.

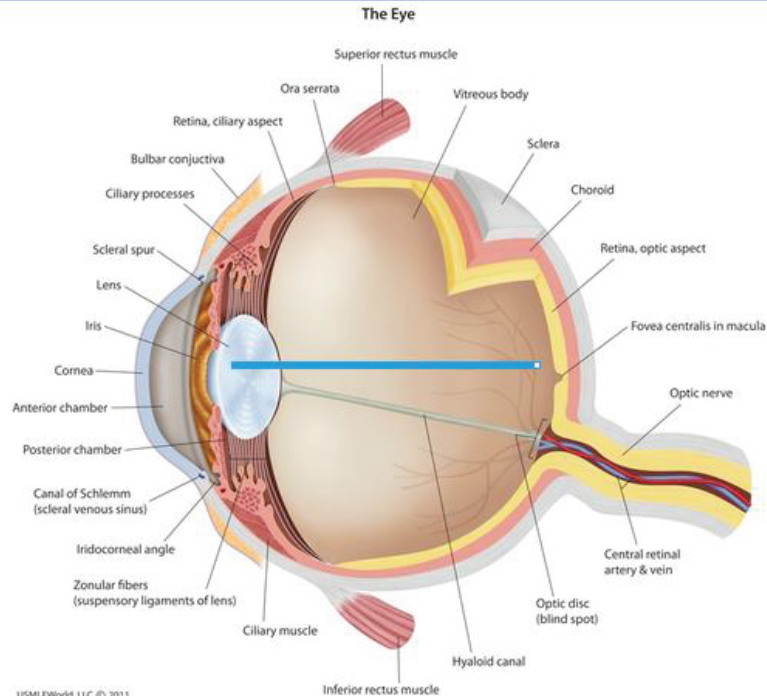
(Choice C) Leukotrienes are inflammatory mediators that contribute to nasal, ocular, and respiratory symptoms in patients with allergic disorders and asthma. Antihistamines do not interfere with leukotriene





This patient has impaired visual accommodation due to anticholinergic (anti-muscarinic) effects of first

Exhibit Display



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Zoom In



Zoom Out



Reset



New | Existing



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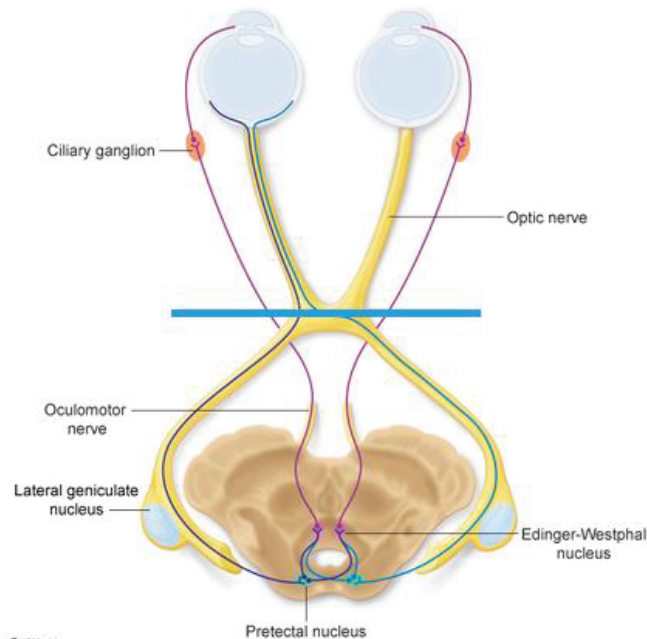




This patient has impaired visual accommodation due to antihypertensive (anti-muscarinic) effects of first

Exhibit Display

Pupillary light reflex



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Zoom In



Zoom Out



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My Notebook





system, where they interfere with the normal neurotransmitter functions of histamine. Side effects can include drowsiness and cognitive dysfunction.

(Choice C) Leukotrienes are inflammatory mediators that contribute to nasal, ocular, and respiratory symptoms in patients with allergic disorders and asthma. Antihistamines do not interfere with leukotriene formation or action.

(Choice D) Alpha-adrenergic blockade causes peripheral vasodilation, resulting in hypotension and postural dizziness.

(Choice E) Serotonin receptor blockade by antihistamines causes appetite stimulation and weight gain.

Educational objective:

In addition to blocking histamine receptors, first-generation antihistamines (eg, chlorpheniramine, diphenhydramine) have antimuscarinic, anti-alpha adrenergic, and anti-serotonergic properties.

Anticholinergic effects on the ocular ciliary muscles impair accommodation and cause blurring of vision for close objects.

Pharmacology

Ophthalmology

Antihistamines

Subject

System

Topic





A 62-year-old woman is brought to the emergency department because of acute chest pain. She also complains of diaphoresis, nausea, and lightheadedness. Her blood pressure is 90/60 mm Hg and pulse is 42/min. An ECG reveals ST-segment elevation in the inferior leads. The appropriate therapy is initiated, including a medication to treat her bradycardia. After initial treatment, her blood pressure is 120/70 mm Hg and pulse is 76/min. However, she now complains of severe right-sided eye pain. Which of the following is the most likely cause for this patient's eye pain?

- ☐ A. Iridocyclitis
- ☐ B. Retinal artery thrombosis
- ☐ C. Acute conjunctivitis
- ☐ D. Glaucoma
- ☐ E. Cataract
- ☐ F. Retinal vein thrombosis
- ☐ G. Retinal detachment
- ☐ H. Vitreous hemorrhage





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- ☐ G. Retinal detachment
- ☐ H. Vitreous hemorrhage

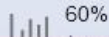
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including a medication to treat her **bradycardia**. After initial treatment, her blood pressure is 120/70 mm Hg and pulse is 76/min. However, she now complains of **severe right-sided eye pain**. Which of the following is the most likely cause for this patient's eye pain?

- ☐ A. Iridocyclitis (2%)
- ☐ B. Retinal artery thrombosis (18%)
- ☐ C. Acute conjunctivitis (0%)
- ☒ D. Glaucoma (60%)
- ☐ E. Cataract (0%)
- ☐ F. Retinal vein thrombosis (6%)
- ☐ G. Retinal detachment (4%)
- ☐ H. Vitreous hemorrhage (6%)

Correct



60%

Answered correctly



01 min, 13 secs

Time spent



02/08/2021

Last updated

Block Time Remaining: 00:25:44

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Feedback



Suspend



End Block

ST-segment elevation in the inferior leads is diagnostic of an inferior myocardial infarction (MI). Inferior MIs are often due to blockage of the right coronary artery, the artery usually responsible for sinoatrial (SA) and atrioventricular (AV) node perfusion. Thus, inferior MIs are often associated with bradycardia. Atropine blocks vagal influence on the SA and AV nodes and is effective in increasing heart rate in such patients. Atropine's side effects are due to muscarinic receptor blockade in other organs. In the eye, atropine causes mydriasis, resulting in narrowing of the anterior chamber angle and diminished outflow of aqueous humor. This can precipitate angle-closure glaucoma in patients with shallow anterior chambers or higher than normal intraocular pressures. Acute closed-angle glaucoma presents with unilateral severe eye pain and visual disturbances (eg, halos). Individuals of Inuit and Asian descent are at increased risk of angle-closure glaucoma.

The clinical indications for anticholinergic medications are summarized in the table.

System	Effect	Clinical use
CNS	Sedation In toxic doses: psychosis	Motion sickness (scopolamine) Parkinson's disease (benztropine)
Eye	Mydriasis (dilated pupil) Cycloplegia (paralysis of accommodation)	Ophthalmologic examination Treatment of uveitis Contraindicated in glaucoma!
Heart	Tachycardia	Sinus bradycardia Heart block (atropine)
Secretions	Decreased lacrimation, sweating, salivation	Premedication before anesthesia

The clinical indications for anticholinergic medications are summarized in the table.

System	Effect	Clinical use
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Eye	Mydriasis (dilated pupil) Cycloplegia (paralysis of accommodation)	Ophthalmologic examination Treatment of uveitis Contraindicated in glaucoma!
Heart	Tachycardia	Sinus bradycardia Heart block (atropine)
Secretions	↓ lacrimation, sweating, salivation, GI and bronchial secretions	Premedication before anesthesia (atropine, scopolamine)
Bladder	Detrusor relaxation, delays voiding	Neurogenic (spastic) bladder (oxybutynin)
Bronchi	Bronchodilatation	Asthma and COPD (ipratropium)

(Choice A) Anticholinergic medications (cycloplegics) reduce pain and prevent the formation of adhesions in iridocyclitis (uveitis). Atropine does not precipitate iridocyclitis.

(Choices B, E, F, G, and H) These conditions present with either loss of vision or visual disturbances. They are usually not painful and would not be affected by anticholinergic drugs.

Educational objective:

Atropine is indicated for the treatment of bradycardia as it decreases vagal influence on the SA and AV nodes. A common side effect is increased intraocular pressure. It may precipitate acute closed-angle

	Cycloplegia (paralysis of accommodation)	Treatment of uveitis Contraindicated in glaucoma!
Heart	Tachycardia	Sinus bradycardia Heart block (atropine)
Secretions	↓ lacrimation, sweating, salivation, GI and bronchial secretions	Premedication before anesthesia (atropine, scopolamine)
Bladder	Detrusor relaxation, delays voiding	Neurogenic (spastic) bladder (oxybutynin)
Bronchi	Bronchodilatation	Asthma and COPD (ipratropium)

(Choice A) Anticholinergic medications (cycloplegics) reduce pain and prevent the formation of adhesions in iridocyclitis (uveitis). Atropine does not precipitate iridocyclitis.

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Educational objective:

Atropine is indicated for the treatment of bradycardia as it decreases vagal influence on the SA and AV nodes. A common side effect is increased intraocular pressure. It may precipitate acute closed-angle glaucoma in susceptible individuals.

Pharmacology Ophthalmology Glaucoma
 Subject System Topic

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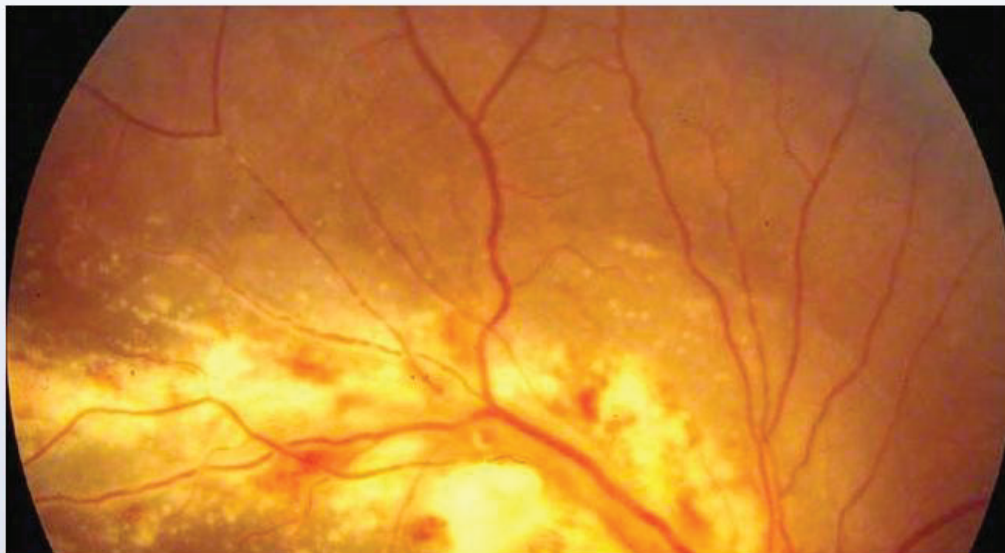
Feedback

Suspend

End Block



A 43-year-old man comes to the emergency department due to painless, progressive visual impairment. The patient was diagnosed with sexually acquired HIV infection 4 years ago. He was previously started on antiretroviral therapy but has been noncompliant with his prescribed medications. His most recent CD4 count was 37 cells/mm³. Physical examination shows no skin rash or corneal lesions. Funduscopy reveals the findings seen in the image below.





Which of the following medications is the best initial therapy for this patient?



A. Acyclovir





Which of the following medications is the best initial therapy for this patient?

- ☐ A. Acyclovir
- ☐ B. Amphotericin B
- ☐ C. Clarithromycin
- ☐ D. Flucytosine
- ☐ E. Ganciclovir
- ☐ F. Penicillin G

Submit





Which of the following medications is the best initial therapy for this patient?

- ☐ A. Acyclovir (10%)
- ☐ B. Amphotericin B (6%)
- ☐ C. Clarithromycin (3%)
- ☐ D. Flucytosine (3%)
- ☒ E. Ganciclovir (74%)
- ☐ F. Penicillin G (1%)

Correct

74%



33 secs



01/02/2021

Block Time Remaining: 00:26:18

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Feedback



Suspend



End Block



Mark



Previous



Next



Full Screen



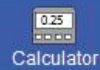
Tutorial



Lab Values



Notes



Calculator



Reverse Color



Text Zoom



Settings



Black arrows = retinal hemorrhage; **White arrows** = CMV granular retinal lesions.
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0



Feedback



Suspend



End Block



Patients with untreated AIDS who have CD4 counts $<50/\text{mm}^3$ are at high risk for **cytomegalovirus (CMV) retinitis**. Suspicion is often raised when a patient with advanced AIDS develops slowly progressive **blurred vision**, scotoma (blind spots), floaters, or photopsia (flashing lights). Although most cases are thought to arise due to hematogenous dissemination of CMV, serum testing for the virus is often (~50%) negative. Therefore, the diagnosis is typically established when funduscopy reveals **yellow-white, fluffy retinal lesions** near the retinal vessels associated with **hemorrhage**.

Treatment is required to prevent progression and blindness. **Ganciclovir**, a guanine nucleoside analogue that is structurally similar to acyclovir but expresses greater activity against CMV DNA polymerase, is first-line therapy. Patients are also typically started on antiretroviral therapy to increase CD4 count. A major complication of CMV retinitis is retinal detachment due to the replacement of damaged retina with thin, atrophic scar tissue (which is prone to tear).

(Choice A) Acyclovir is used to treat herpes simplex (HSV) and varicella zoster virus (VZV) infections. Although these infections occasionally cause acute retinal necrosis, most cases arise in older, immunocompetent individuals (not patients with advanced AIDS). In addition, HSV retinitis and VZV retinitis are usually associated with significant vitreal inflammation, spotty peripheral retinal lesions, and infrequent hemorrhage.





infrequent hemorrhage.

(Choice B) *Candida* endophthalmitis is treated with amphotericin B. Funduscopy usually reveals focal, white, mound-like lesions on the retina. Most cases occur in the setting of an indwelling central venous catheter or total parenteral nutrition.

(Choice C) Clarithromycin is used in conjunction with other antibiotics for the treatment of *Mycobacterium avium* complex infection, which usually causes fever, night sweats, abdominal pain, and diarrhea.

(Choice D) *Cryptococcus neoformans* infections are treated with flucytosine, a fluorinated analog of cytosine, in combination with amphotericin B. Although cryptococcal endophthalmitis can occur in patients with advanced AIDS, it is much less common than CMV retinitis, and patients often have other manifestations of cryptococcal infection such as skin lesions or meningoencephalitis.

(Choice F) Penicillin G is used to treat ocular (and neuro-) syphilis. Ocular syphilis often presents as uveitis but can cause retinitis, which usually appears as ground-glass lesions with significant vitreal inflammation. Most patients also have manifestations of syphilitic meningitis (eg, headache, vomiting).

Educational objective:

Cytomegalovirus retinitis is the most common cause of ocular disease in patients with untreated AIDS who have CD4 counts $<50/\text{mm}^3$. Diagnosis is made by funduscopy, which typically reveals yellow white, fluffy





(Choice C) Clarithromycin is used in conjunction with other antibiotics for the treatment of *Mycobacterium avium* complex infection, which usually causes fever, night sweats, abdominal pain, and diarrhea.

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(Choice F) Penicillin G is used to treat ocular (and neuro-) syphilis. Ocular syphilis often presents as uveitis but can cause retinitis, which usually appears as ground-glass lesions with significant vitreal inflammation. Most patients also have manifestations of syphilitic meningitis (eg, headache, vomiting).

Educational objective:

Cytomegalovirus retinitis is the most common cause of ocular disease in patients with untreated AIDS who have CD4 counts $<50/\text{mm}^3$. Diagnosis is made by funduscopy, which typically reveals yellow-white, fluffy retinal lesions near the retinal vessels with associated hemorrhage. Treatment with ganciclovir is required to prevent blindness.

Pharmacology

Ophthalmology

Cytomegalovirus





A 64-year-old African American woman is brought to the clinic by her husband due to a fall. She was walking in her living room when she tripped over an electrical cord. The patient has had several other ground-level falls in the last 6 months but has had no significant injuries. She also gave up driving a year ago following a near-miss motor vehicle accident. Past medical history is notable for hypertension and type 2 diabetes mellitus, for which she takes appropriate medications. Mental status and neurologic examinations are normal. Ophthalmic examination reveals reduced vision in her peripheral visual fields bilaterally and an elevated intraocular pressure. After discussion of treatment options, the patient is initiated on timolol ophthalmic drops. Which of the following structures is the most likely target of this medication?

- ☐ A. Ciliary epithelium
- ☐ B. Ciliary muscle
- ☐ C. Lens
- ☐ D. Pupil sphincter
- ☐ E. Trabecular meshwork





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- ☒ A. Ciliary epithelium (42%)
- ☐ B. Ciliary muscle (27%)
- ☐ C. Lens (0%)
- ☐ D. Pupil sphincter (7%)
- ☐ E. Trabecular meshwork (20%)

Correct



42%



01 min, 05 secs
Time Spent



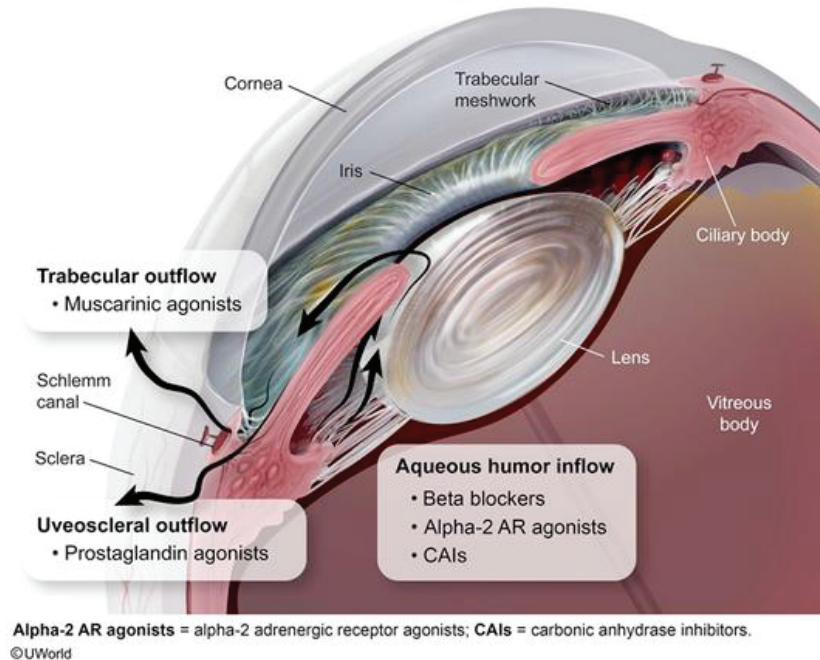
09/30/2020
Last Updated





Exhibit Display

Glaucoma medications



Zoom In



Zoom Out



Reset



New | Existing



My Notebook





This patient with chronic, progressive loss of peripheral vision has typical features of **open-angle glaucoma**. Glaucoma is a type of **optic neuropathy** characterized by atrophy of the optic nerve head. It is more common with advancing age and is especially common in certain ethnicities (eg, African Americans). Glaucoma is usually associated with **elevated intraocular pressure** (IOP) due to increased production or decreased outflow of aqueous humor. **Aqueous humor** is produced by the epithelial cells of the ciliary body. It is secreted into the posterior eye chamber and transferred through the pupil into the anterior eye chamber. The anterior chamber angle (iridocorneal angle) contains a trabecular meshwork through which the aqueous humor diffuses into Schlemm's canal (scleral venous sinus) and subsequently into episcleral and conjunctival veins.

Diagnostic features of glaucoma include elevated IOP and abnormal visual field testing with decreased peripheral vision. Fundusoscopic examination will show an **increased cup-to-disc ratio** due to loss of ganglion cell axons. The goal of treatment in glaucoma is to decrease IOP with drugs that either decrease the production of aqueous humor or increase its outflow. Timolol and other nonselective beta blockers work by diminishing the secretion of aqueous humor by the ciliary epithelium.

(Choices B, C, D, and E) The intraocular muscles of the eye, including the ciliary muscle and pupillary sphincter of the iris, receive parasympathetic innervation from cholinergic fibers of the oculomotor nerve

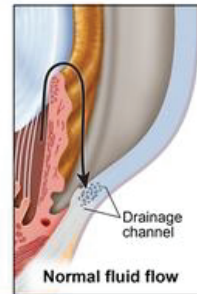
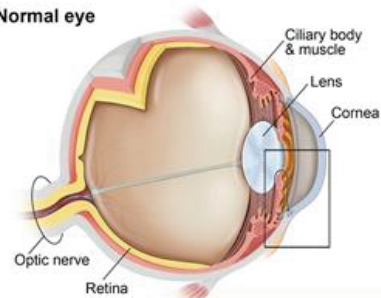




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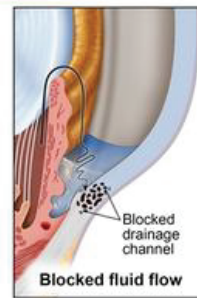
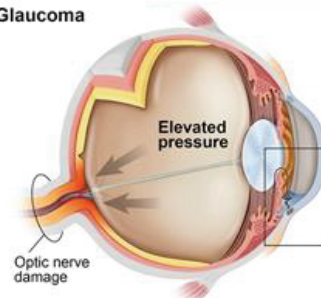
Glaucoma pathophysiology

Normal eye



Normal fluid flow

Glaucoma



Blocked fluid flow

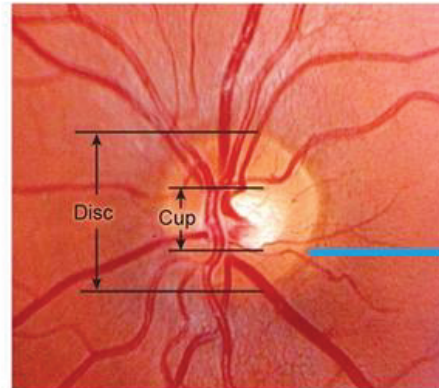




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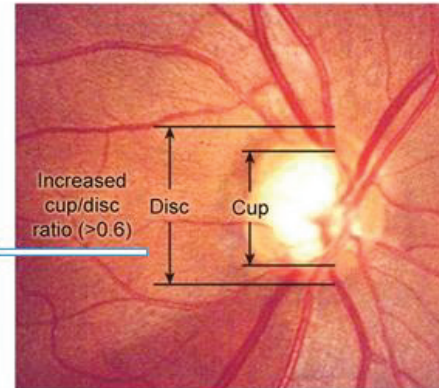
Optic disc in glaucoma

Normal



- Cup/disc ratio <0.5
- Clear disc rim

Open-angle glaucoma



- Enlarged cup with cup/disc ratio >0.6
- Increase in cup size over time
- Thinning of disc rim
- Pale disc (optic nerve atrophy)





diminishing the secretion of aqueous humor by the ciliary epithelium.

(Choices B, C, D, and E) The intraocular muscles of the eye, including the ciliary muscle and pupillary sphincter of the iris, receive parasympathetic innervation from cholinergic fibers of the oculomotor nerve (cranial nerve III). Cholinergic agonists (eg, pilocarpine) cause miosis by promoting contraction of the sphincter of the iris. This causes the anterior chamber angle to become wider and makes the trabecular meshwork more accessible to outflow of aqueous humor. Cholinergic agonists also promote ciliary muscle contraction, causing the lens to become more convex.

Educational objective:

Open-angle glaucoma is characterized by progressive loss of peripheral vision from elevated intraocular pressure. Timolol and other nonselective beta blockers work by diminishing the secretion of aqueous humor by the ciliary epithelium. Acetazolamide, a carbonic anhydrase inhibitor, also decreases aqueous humor secretion by the ciliary epithelium. Prostaglandin F_{2α} (eg, latanoprost, travoprost) and cholinomimetics (eg, pilocarpine, carbachol) decrease intraocular pressure by increasing the outflow of aqueous humor.

Pharmacology

Ophthalmology

Glaucoma

Subject

System

Topic





A 50-year-old woman who has had mild myopia for decades comes to the office for a routine physical examination. The patient has no chronic medical conditions and eats a healthy diet consisting of a variety of organically grown foods. She is excited because she rarely has to wear glasses or contacts anymore. Her visual acuity at 20 feet is 20/30 in both eyes without wearing her glasses. Which of the following conditions has the same etiology as the changes causing this patient's visual improvement?

- ☐ A. Actinic keratosis
- ☐ B. Angle-closure glaucoma
- ☐ C. Coronary atherosclerosis
- ☐ D. Femoral head osteonecrosis
- ☐ E. Skin wrinkles

Submit



A 50-year-old woman who has had mild myopia for decades comes to the office for a routine physical examination. The patient has no chronic medical conditions and eats a healthy diet consisting of a variety of organically grown foods. She is excited because she rarely has to wear glasses or contacts anymore. Her visual acuity at 20 feet is 20/30 in both eyes without wearing her glasses. Which of the following conditions has the same etiology as the changes causing this patient's visual improvement?

- ☐ A. Actinic keratosis (10%)
- ☐ B. Angle-closure glaucoma (14%)
- ☐ C. Coronary atherosclerosis (7%)
- ☐ D. Femoral head osteonecrosis (1%)
- ☒ E. Skin wrinkles (65%)

Correct



65%
Answered correctly



01 min, 26 secs
Time Spent



10/14/2020
Last Updated





Item 16 of 27

Question Id: 862



Mark



Previous



Next



Full Screen



Tutorial



Lab Values



Notes



Calculator



Reverse Color



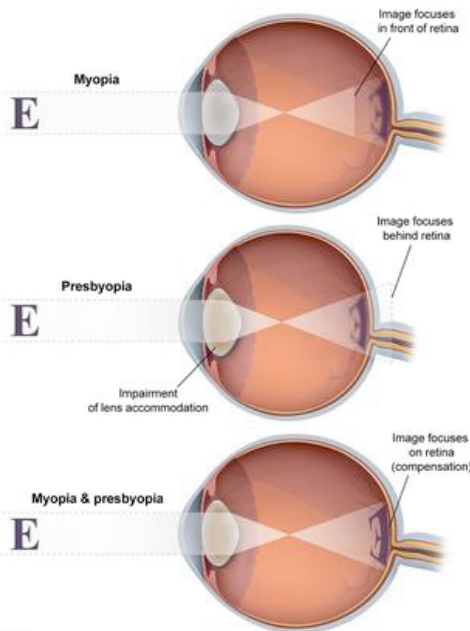
Text Zoom



Settings

Exhibit Display

Interaction between presbyopia & myopia



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Zoom In



Zoom Out



Reset



New | Existing



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Block Time Remaining: 00:28:49

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Feedback



Suspend



End Block



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The improvement in this patient's mild myopia is likely due to **age-related changes**. Normally, in **accommodation**, when focusing on near objects (eg, reading), ciliary muscle contraction relaxes the zonular fibers, allowing the lens to become more convex so the image focuses **on the retina**.

Starting around age 40-50, almost all individuals develop an inability to focus on near objects. In this condition, called **presbyopia**, progressive denaturation of lens proteins and changes in lens curvature cause the lens to become less elastic and lose its accommodating power. In most patients, this causes the image of near objects to focus **behind the retina** resulting in difficulty reading fine print and the need to hold objects farther away in order to see them clearly. However, in patients with mild **myopia** (increased axial length with an image focused **in front of the retina**), presbyopia can **compensate** for myopia by displacing the image backward, so that it focuses on the retina. These patients often note improvement in visual acuity with age as presbyopia develops.

Skin rhytides (**wrinkles**) are also directly caused by chronological aging (with a contribution from the harmful effects of ultraviolet light). With aging, skin becomes atrophic and fragile, with reduced elasticity and subdermal fat. There is dermal and epidermal thinning, flattening of the dermoepidermal junction, a decreased number of fibroblasts, and reduced synthesis and increased breakdown of collagen and elastin.





Exhibit Display

Changes associated with normal aging		
System	Physiologic effects	Medical complications
Cardiovascular	<ul style="list-style-type: none">• ↓ maximum heart rate• Thickening & calcification of the aorta	<ul style="list-style-type: none">• ↓ exercise capacity• Systolic hypertension
Gastrointestinal	<ul style="list-style-type: none">• ↑ gastric acid reflux• ↓ colonic motility	<ul style="list-style-type: none">• Gastroesophageal reflux disease• Chronic constipation
Urinary	<ul style="list-style-type: none">• ↓ ability to concentrate urine• Impaired emptying of the bladder	<ul style="list-style-type: none">• Dehydration• Urinary tract infections & incontinence
Immune	<ul style="list-style-type: none">• ↓ numbers of B & T cells	<ul style="list-style-type: none">• ↑ respiratory & nosocomial infections, malignancies, & autoimmune conditions
Musculoskeletal	<ul style="list-style-type: none">• ↓ muscle mass• ↑ bone mineral loss	<ul style="list-style-type: none">• ↑ risk of falls• ↑ fracture risk
Integumentary	<ul style="list-style-type: none">• Skin atrophy• ↓ subdermal fat	<ul style="list-style-type: none">• ↑ skin fragility• Skin wrinkling
Sensory	<ul style="list-style-type: none">• Hardening of the ocular lens• Deterioration of auditory pathway	<ul style="list-style-type: none">• Presbyopia• Presbycusis

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Zoom In



Zoom Out



Reset



New | Existing



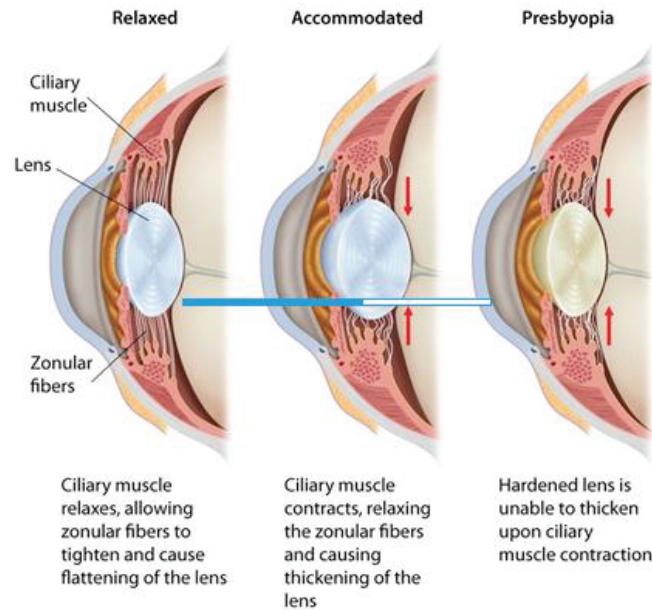
My Notebook





Exhibit Display

Ocular accommodation and presbyopia



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Zoom In



Zoom Out



Reset



New | Existing



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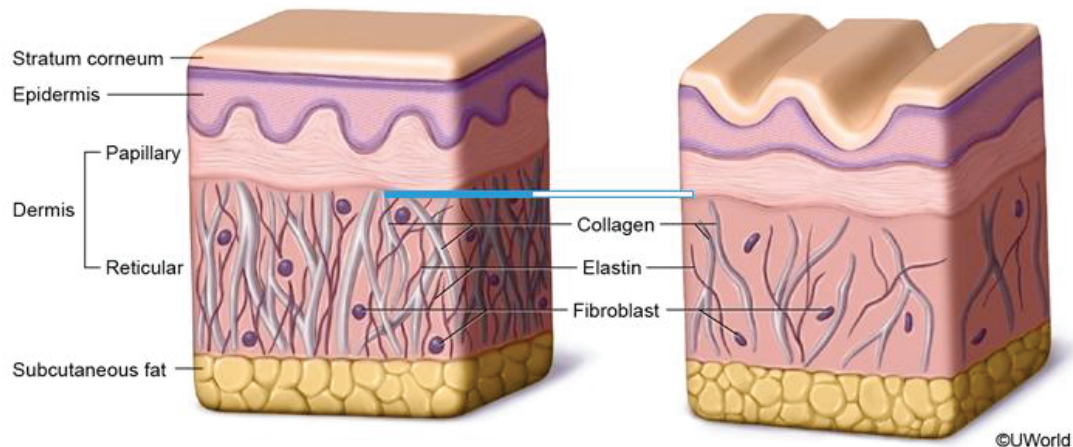


Exhibit Display

Wrinkles

Young skin

Aging skin



Zoom In



Zoom Out



Reset



New



Existing



My Notebook





and subdermal fat. There is dermal and epidermal thinning, flattening of the dermoepidermal junction, a decreased number of fibroblasts, and reduced synthesis and increased breakdown of collagen and elastin.

(Choices A, B, and C) Although age is a risk factor for actinic keratoses, angle-closure glaucoma, and atherosclerosis, age-related changes themselves do not cause these conditions. Actinic keratoses (ie, premalignant lesions increasing squamous cell carcinoma risk) are rough, scaly, erythematous papules on sun-exposed areas that result from ultraviolet damage. Angle-closure glaucoma occurs due to impaired aqueous humor flow. Atherosclerosis is primarily attributable to hyperlipidemia, hypertension, and genetic (familial) predisposition.

(Choice D) Femoral head osteonecrosis is associated with vasculitis (lupus), corticosteroid therapy, sickle cell disease, and alcoholism. It is not an age-related condition and can occur in children (eg, Legg-Calve-Perthes disease).

Educational objective:

Presbyopia and skin wrinkles are age-related changes. Presbyopia occurs due to denaturation of structural proteins within the lens, leading to loss of lens elasticity which can result in improved vision in patients with mild myopia. Decreased synthesis and increased breakdown of collagen and elastin contribute to the development of skin wrinkles.

